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200891

April 19, 1996

Ms. Sheri Bianchin, RPM
United States Environmental Protection Agency
Region V (HSR-6J)
77 West Jackson Blvd.
Chicago, IL 60604-3590

RE: Submittal of Correction Pages
Dewatering/Barrier Wall Alignment Investigation Report
ACS NPL Site RD/RA
Griffith, Indiana

Dear Ms. Bianchin:

As indicated on Page 6 of the Dewatering/Barrier Wall Alignment Investigation Report, the results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) were not ready in time for inclusion with the report on the April 1 submittal date. The tests have since been completed and are submitted at this time for inclusion in the Barrier Wall Report.

Please replace the following pages in the previous submittal with the attached pages. Five sets have been included, one for each of the five reports submitted to you on April 1, 1996.

Page 6
Page 14
Table 3

In addition, please place the test results after the Appendix F tab.

If you have any questions, or need additional copies, please call me at (630) 691-5020.

Sincerely,

MONTGOMERY WATSON

Peter J. Vagt, Ph.D., CPG
Vice President

cc: Holly Grejda/IDEM (5)
Steve Mrkvika, B&VWS (2)
ACS Technical Committee

3.3 LABORATORY ANALYSIS

Soil samples which indicated VOC concentration greater than 8,000 ppm from the field GC analytical results, or PCB concentrations close to 10 ppm from the Ohmicron Rapid Assay Soil Field Test kit were sent to IEA Analytical Laboratories in Cary, North Carolina for confirmatory analyses in accordance with the Contract Laboratory Program (CLP) Statement of Work.

A summary of the analytical laboratory results and comparison to the field GC and PCB test kits are presented in Table 2. The complete IEA Laboratory report is presented in Appendix E.

3.4 GEOTECHNICAL LABORATORY ANALYSIS

Geotechnical laboratory analysis performed at CGC, Inc. of Madison, Wisconsin included: grain size distribution (ASTM D422) for granular, Atterberg limits (liquid limit and plasticity index) (ASTM D4318), grain size distribution (ASTM D422), and flexible-wall permeability tests (ASTM D5084) for samples from the clay confining layer. Rigid-wall falling head permeability testing was performed on four Shelby tube samples of the confining clay layer.

Geotechnical laboratory testing for the soil-bentonite mix design and compatibility testing was not performed at this time. As previously stated, these tests will be performed by our construction subcontractor, as necessary, to select a soil-bentonite mix for sections of the barrier wall to be constructed as a bentonite slurry wall.

Geotechnical analyses of selected soil samples were conducted in accordance with the Dewatering/Barrier Wall Alignment Pre-Design Work Plan, with the following exceptions:

- Soil samples collected for grain size analysis along the proposed final alignment were analyzed at intervals greater than 200 feet. Because the original 200-foot spacing of soil samples for grain size analysis was based on a shorter length of alignment, increasing the proposed alignment length served to extend the distance between samples. Due to the consistent geology over the entire site, little variation in grain size was noted between borings located more than 200 feet apart (see Section 7). Soil samples were collected from all borings conducted during the investigation and are currently being stored. These soil samples will be available for additional grain size analyses in the future, if necessary.
- A flexible-wall hydraulic conductivity/permeability test (ASTM D5084) was not performed on the one of the four clay confining layers samples (SB206) because there was insufficient volume of the undisturbed Shelby tube sample.
- In addition to the flexible-wall hydraulic conductivity/permeability testing, rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM

GEOTECHNICAL RESULTS

The geotechnical laboratory results performed on selected soil samples are summarized on Table 3. The laboratory reports are presented in Appendix F.

The granular soils above the clay confining layer are generally classified as a fine to coarse sand with a trace to some silt and clay, and have the Unified Soil Classification System (USCS) symbols of SP, SP-SM, and SM. The clay confining layer is generally classified as clay with a USCS symbol of CL.

According to the rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM 1110-2-1906 (VII)), the permeability of the clay confining layer ranged from 1.7×10^{-8} cm/s (centimeters per second) to 2.4×10^{-8} cm/s based on relatively undisturbed Shelby tube samples. Liquid and plasticity limits ranged from 28-30% and 11-14%, respectively (Table 3).

The results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) for SB109 and SB151 show the permeability of the clay confining layer to be 2.0×10^{-8} cm/sec and 2.4×10^{-8} , respectively. These data are consistent with the permeability values calculated from the falling head method. The result for sample SB212, using the flexible wall method, is two orders of magnitude greater than the result from the falling head method (Table 3). The sample used for the flexible wall method was observed to be more silty than the sample used for the falling head method.

Table 3
Geotechnical Laboratory Results Summary
Barrier Wall Alignment Report
American Chemical Service, Inc.
Griffith, Indiana

Soil Boring Number	Sample Number	Coordinates		Sample Depth (ft)	Liquid Limit (%)	Plasticity Index (%)	Gravel Content (%)	Sand Content (%)	P200 Content (%)	USCS	Permeability	
		Northing	Easting								Rigid Wall (cm/s)	Flexible Wall (cm/s)
SB-212	SS4	5759	5454	7-9	NA	NA	0.0	86.9	13.1	SM	NA	NA
SB-212	SS9	5759	5454	17-19	NA	NA	5.5	87.1	7.4	SW-SM	NA	NA
SB-215	SS5	6126	5615	9-11	NA	NA	4.0	87.5	8.5	SP-SM	NA	NA
SB-215	SS10	6126	5615	19-21	NA	NA	19.8	76.5	3.7	SP	NA	NA
SB-217	SS4	6444	5603	7-9	NA	NA	32.4	62.1	5.5	SP-SM	NA	NA
SB-217	SS10	6444	5603	19-21	NA	NA	0.9	83.9	15.2	SM	NA	NA
SB-206	SS4	5856	5013	7-9	NA	NA	0.2	92.0	7.8	SP-SM	NA	NA
SB-206	SS7	5856	5013	13-15	NA	NA	0.0	90.9	9.1	SP-SM	NA	NA
SB-151	SS5	6764	5890	9-11	NA	NA	14.2	82.4	3.4	SP	NA	NA
SB-151	SS7	6764	5890	13-15	NA	NA	9.2	87.6	3.2	SP	NA	NA
SB-152	SS3	6607	5819	5-7	NA	NA	5.7	87.2	7.1	SP-SM	NA	NA
SB-152	SS10	6607	5819	19-21	NA	NA	11.5	76.3	12.2	SM	NA	NA
SB-221	SS2	6354	5138	3-5	NA	NA	0.0	90.5	9.5	SP-SM	NA	NA
SB-221	SS5	6354	5138	9-11	NA	NA	0.2	87.5	12.3	SM	NA	NA
SB-109	SS3	7027	5308	5-7	NA	NA	0.0	96.6	3.4	SP	NA	NA
SB-109	SS8	7027	5308	15-17	NA	NA	11.4	80.6	8.0	SP-SM	NA	NA
SB-136	SS2	6904	5146	3-5	NA	NA	2.0	93.0	5.0	SP-SM	NA	NA
SB-136	SS6	6904	5146	11-13	NA	NA	4.2	88.4	7.4	SP-SM	NA	NA
SB-113	SS5	7066	5422	9-11	NA	NA	0.5	92.3	7.2	SP-SM	NA	NA
SB-113	SS6	7066	5422	11-13	NA	NA	8.4	88.0	3.6	SP	NA	NA
SB-112	SS5	6935	5576	9-11	NA	NA	8.1	74.9	17.0	SM	NA	NA
SB-112	SS8	6935	5576	15-17	NA	NA	0.4	95.0	4.6	SP	NA	NA
SB-109	ST	7027	5308	19-21	30	14	1.9	7.9	90.2	CL	1.7E-08	2.0E-08
SB-151	ST	6764	5890	23-25	29	11	0.9	12.1	87.0	CL	2.0E-08	2.4E-08
SB-206	ST	5856	5013	25.5-27.5	28	12	3.3	14.3	82.4	CL	1.8E-08	NT
SB-212	ST	5759	5454	29-31	28	11	0.7	10	89.3	RP	2.4E-08	1.3E-06

Notes:

ST = Shelby tube sample

NA = Test not applicable to this sample

NT = Sample not tested because of insufficient volume of undisturbed material

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB109, 19-21'

Date: 03-Apr-96
Tech: DEO
File: 394101
Call #: 8
Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

	INIT.	FINAL		
Sample Dia. (in)	2.86	2.86	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	200.5	616.0	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	188.5	539.1	Confining Pressure (psi):	100.0
Tare (g)	114.5	87.2	Burette Diameter (in):	0.250
Sample Wt. (g)	528.5	528.8	Burette Zero (cm):	100.0

****CALCULATED VALUES****

MOISTURE (%)	16.2	17.0	MAXIMUM GRADIENT:	12.2
WET DENS. (pcf)	136.3	136.3	AVERAGE GRADIENT:	10.6
DRY DENS. (pcf)	117.3	116.5	MAX. EFFECT. STRESS (psi):	5.7
SATURATION (%)	100.2	103.0	MIN. EFFECT. STRESS (psi):	4.3
			AVE. EFFECT. STRESS (psi):	4.7

Date			Time		Temp MM Co*	Press.(psi)		Readings (cm)			Flow Dif. %	Kv ** cm/sec	Ave. 0,1
YY	MM	DD	HH			BOT	TOP	CHAM	BOT	TOP			
96	3	26	7	49.00	0.0	95	95	52.30	1.65	99.85			
96	3	26	8	40.00	20.0	95	95	52.75	1.80	99.50	-40.0	3.7E-08	
96	3	26	9	31.00	20.0	95	95	53.05	2.10	99.30	20.0	3.7E-08	
96	3	26	14	20.00	20.0	95	95	54.45	3.30	98.35	11.6	2.9E-08	
96	3	26	16	23.00	20.0	95	95	55.05	3.75	97.90	0.0	2.9E-08	
96	3	27	7	41.00	20.5	95	95	58.35	7.00	95.05	6.6	2.7E-08	
96	3	27	15	55.00	21.5	95	95	60.80	8.55	93.65	5.1	2.5E-08	
96	3	28	7	51.00	21.0	95	95	62.60	11.30	91.30	7.8	2.3E-08	
96	3	28	13	1.00	21.0	95	95	63.75	12.15	90.60	9.7	2.3E-08	
96	3	29	9	7.00	21.0	95	95	66.30	15.00	87.90	2.7	2.2E-08	
96	3	29	13	32.00	22.0	95	95	67.35	15.55	87.35	-0.0	2.0E-08	
96	3	29	15	41.00	0.0	95	95	67.60	15.90	87.15			
96	4	1	7	33.00	21.0	95	95	72.75	23.20	80.50	4.7	2.1E-08	1
96	4	1	15	10.00	22.0	95	95	74.15	23.95	79.85	7.1	1.9E-08	1
96	4	2	7	23.00	21.0	95	95	74.40	25.40	78.35	-1.7	2.0E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.0E-08 cm/sec
Termination determined by stable Kv and low flow differential 7.9E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

Falling Head Permeability Test
(Version 1.02)

Project: CGC, Inc.
Project #: 3941.01
Sample: SB151, 23-25'

Date: 03-Apr-96
Tech: DEO
File: 394102
Cell #: 9

Page: 1 of 1

Visual Descript: Lean clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.85	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	211.4	598.5	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	196.3	513.5	Confining Pressure (psi):	100.0
Tare (g)	116.1	84.0	Burette Diameter (in):	0.250
Sample Wt. (g)	513.0	514.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	18.9	19.8	MAXIMUM GRADIENT:	9.5
WET DENS. (pcf)	133.2	133.6	AVERAGE GRADIENT:	8.9
DRY DENS. (pcf)	112.0	111.5	MAX. EFFECT. STRESS (psi):	5.8
SATURATION (%)	101.2	104.6	MIN. EFFECT. STRESS (psi):	4.4
			AVE. EFFECT. STRESS (psi):	4.9

Date		Time		Temp		Press. (psi)		Readings (cm)			Flow Dif.	Kv **	Ave.
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	3	27	7	53.00	0.0	95	95	43.20	2.25	100.15			
96	3	27	8	29.00	20.5	95	95	43.10	2.50	99.65	-33.3	8.0E-08	
96	3	27	9	9.00	20.5	95	95	43.35	2.75	99.40	0.0	4.8E-08	
96	3	27	15	53.00	21.5	95	95	45.45	4.90	97.35	2.4	4.0E-08	
96	3	28	7	53.00	21.0	95	95	48.00	9.10	93.55	5.0	3.4E-08	
96	3	28	13	0.00	21.0	95	95	49.15	10.30	92.50	6.7	3.2E-08	
96	3	29	9	6.00	21.0	95	95	51.70	14.30	88.70	2.6	3.0E-08	
96	3	29	13	33.00	22.0	95	95	52.65	15.05	87.95	0.0	2.7E-08	
96	3	29	15	40.00	22.0	95	95	52.85	15.45	87.65	14.3	2.7E-08	
96	4	1	7	34.00	21.0	95	95	59.10	24.15	79.40	2.7	2.6E-08	
96	4	1	15	9.00	22.0	95	95	60.15	25.00	78.65	6.3	2.3E-08	1
96	4	2	7	24.00	21.0	95	95	60.75	26.60	77.00	-1.5	2.3E-08	1
96	4	2	12	57.00	21.5	95	95	61.15	27.20	76.50	9.1	2.4E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
Termination determined by stable Kv and low flow differential 9.3E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

SPH
4/3/96

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB 212, 29-31'

Date: 03-Apr-96
Tech: DEO
File: 394103A
Cell #: 10

Page:2 of 2

Visual Descript:Silty clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.86	Permeant: WATER	
Sample Ht. (in)	1.99	1.99	Permeant Specific Gravity:	1.00
Tare & Wet (g)	210.4	698.9	Sample Specific Gravity:	2.65 EST.
Tare & Dry (g)	196.0	627.1	Confining Pressure (psi):	100.0
Tare (g)	114.2	270.4	Burette Diameter (in):	0.250
Sample Wt. (g)	424.9	428.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	17.6	20.1	MAXIMUM GRADIENT:	15.7
WET DENS. (pcf)	127.5	127.7	AVERAGE GRADIENT:	13.4
DRY DENS. (pcf)	108.4	106.3	MAX. EFFECT. STRESS (psi):	6.0
SATURATION (%)	88.8	96.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.3

Date	Time	Temp	Press.(psi)	Readings (cm)	Flow Dif.	Kv **	Ave.
YY MM DD	HH	MM Co*	BOT TOP	CHAM BOT TOP	%	cm/sec	0,1
96 4 1	7 37.00	0.0	95 95	28.70 1.60 100.40			
96 4 1	7 53.00	21.0	95 95	28.60 6.60 95.15	-2.4	2.2E-06	
96 4 1	8 20.00	21.0	95 95	28.65 13.30 88.50	0.4	1.9E-06	
96 4 1	8 55.00	21.0	95 95	28.80 20.20 81.75	1.1	1.8E-06	
96 4 1	10 1.00	21.0	95 95	29.00 29.46 72.55	0.3	1.7E-06	
96 4 2	14 14.00	0.0	95 95	32.30 2.70 99.70			
96 4 2	14 33.00	21.0	95 95	32.20 6.60 95.55	-3.1	1.4E-06	
96 4 2	14 43.00	21.0	95 95	32.35 8.40 93.65	-2.7	1.3E-06	
96 4 2	15 0.00	21.0	95 95	32.20 11.35 90.70	-0.0	1.3E-06	
96 4 2	15 21.00	21.0	95 95	32.05 14.60 87.45	0.0	1.3E-06	1
96 4 2	15 39.00	21.0	95 95	32.05 17.25 84.85	1.0	1.3E-06	1
96 4 2	16 1.00	21.0	95 95	32.00 20.15 81.95	0.0	1.3E-06	1
96 4 2	16 20.00	21.0	95 95	32.10 22.50 79.60	-0.0	1.3E-06	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

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Termination determined by stable Kv and low flow differential 5.1E-07 in/sec
* A zero in this column starts a series of measurements
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3.3 LABORATORY ANALYSIS

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Geotechnical analyses of selected soil samples were conducted in accordance with the Dewatering/Barrier Wall Alignment Pre-Design Work Plan, with the following exceptions:

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The results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) for SB109 and SB151 show the permeability of the clay confining layer to be 2.0×10^{-8} cm/sec and 2.4×10^{-8} , respectively. These data are consistent with the permeability values calculated from the falling head method. The result for sample SB212, using the flexible wall method, is two orders of magnitude greater than the result from the falling head method (Table 3). The sample used for the flexible wall method was observed to be more silty than the sample used for the falling head method.

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SB-215	SS10	6126	5615	19-21	NA	NA	19.8	76.5	3.7	SP	NA	NA
SB-217	SS4	6444	5603	7-9	NA	NA	32.4	62.1	5.5	SP-SM	NA	NA
SB-217	SS10	6444	5603	19-21	NA	NA	0.9	83.9	15.2	SM	NA	NA
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SB-221	SS2	6354	5138	3-5	NA	NA	0.0	90.5	9.5	SP-SM	NA	NA
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SB-109	SS8	7027	5308	15-17	NA	NA	11.4	80.6	8.0	SP-SM	NA	NA
SB-136	SS2	6904	5146	3-5	NA	NA	2.0	93.0	5.0	SP-SM	NA	NA
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SB-113	SS6	7066	5422	11-13	NA	NA	8.4	88.0	3.6	SP	NA	NA
SB-112	SS5	6935	5576	9-11	NA	NA	8.1	74.9	17.0	SM	NA	NA
SB-112	SS8	6935	5576	15-17	NA	NA	0.4	95.0	4.6	SP	NA	NA
SB-109	ST	7027	5308	19-21	30	14	1.9	7.9	90.2	CL	1.7E-08	2.0E-08
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Notes:

ST = Shelby tube sample

NA = Test not applicable to this sample

NT = Sample not tested because of insufficient volume of undisturbed material

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB109, 19-21'

Date: 03-Apr-96
Tech: DEO
File: 394101
Cell #: 8

Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

	INIT.	FINAL		Permeant: WATER
Sample Dia. (in)	2.86	2.86		
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	200.5	616.0	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	188.5	539.1	Confining Pressure (psi):	100.0
Tare (g)	114.5	87.2	Burette Diameter (in):	0.250
Sample Wt. (g)	528.5	528.8	Burette Zero (cm):	100.0

****CALCULATED VALUES****

MOISTURE (%)	16.2	17.0	MAXIMUM GRADIENT:	12.2
WET DENS. (pcf)	136.3	136.3	AVERAGE GRADIENT:	10.6
DRY DENS. (pcf)	117.3	116.5	MAX. EFFECT. STRESS (psi):	5.7
SATURATION (%)	100.2	103.0	MIN. EFFECT. STRESS (psi):	4.3
			AVE. EFFECT. STRESS (psi):	4.7

Date		Time	Temp	Press.(psi)	Readings (cm)			Flow Dif.	Kv **	Ave.			
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	3	26	7	49.00	0.0	95	95	52.30	1.65	99.85			
96	3	26	8	40.00	20.0	95	95	52.75	1.80	99.50	-40.0	3.7E-08	
96	3	26	9	31.00	20.0	95	95	53.05	2.10	99.30	20.0	3.7E-08	
96	3	26	14	20.00	20.0	95	95	54.45	3.30	98.35	11.6	2.9E-08	
96	3	26	16	23.00	20.0	95	95	55.05	3.75	97.90	0.0	2.9E-08	
96	3	27	7	41.00	20.5	95	95	58.35	7.00	95.05	6.6	2.7E-08	
96	3	27	15	55.00	21.5	95	95	60.80	8.55	93.65	5.1	2.5E-08	
96	3	28	7	51.00	21.0	95	95	62.60	11.30	91.30	7.8	2.3E-08	
96	3	28	13	1.00	21.0	95	95	63.75	12.15	90.60	9.7	2.3E-08	
96	3	29	9	7.00	21.0	95	95	66.30	15.00	87.90	2.7	2.2E-08	
96	3	29	13	32.00	22.0	95	95	67.35	15.55	87.35	-0.0	2.0E-08	
96	3	29	15	41.00	0.0	95	95	67.60	15.90	87.15			
96	4	1	7	33.00	21.0	95	95	72.75	23.20	80.50	4.7	2.1E-08	1
96	4	1	15	10.00	22.0	95	95	74.15	23.95	79.85	7.1	1.9E-08	1
96	4	2	7	23.00	21.0	95	95	74.40	25.40	78.35	-1.7	2.0E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.0E-08 cm/sec
Termination determined by stable Kv and low flow differential 7.9E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

Falling Head Permeability Test
(Version 1.02)

Project: CGC, Inc.
Project #: 3941.01
Sample: SB151, 23-25'

Date: 03-Apr-96
Tech: DEO
File: 394102
Cell #: 9

Page: 1 of 1

Visual Descript: Lean clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.85	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	211.4	598.5	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	196.3	513.5	Confining Pressure (psi):	100.0
Tare (g)	116.1	84.0	Burette Diameter (in):	0.250
Sample Wt. (g)	513.0	514.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	18.9	19.8	MAXIMUM GRADIENT:	9.5
WET DENS. (pcf)	133.2	133.6	AVERAGE GRADIENT:	8.9
DRY DENS. (pcf)	112.0	111.5	MAX. EFFECT. STRESS (psi):	5.8
SATURATION (%)	101.2	104.6	MIN. EFFECT. STRESS (psi):	4.4
			AVE. EFFECT. STRESS (psi):	4.9

Date	Time	Temp	Press. (psi)	Readings (cm)	Flow Dif.	Kv **	Ave.						
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	3	27	7	53.00	0.0	95	95	43.20	2.25	100.15			
96	3	27	8	29.00	20.5	95	95	43.10	2.50	99.65	-33.3	8.0E-08	
96	3	27	9	9.00	20.5	95	95	43.35	2.75	99.40	0.0	4.8E-08	
96	3	27	15	53.00	21.5	95	95	45.45	4.90	97.35	2.4	4.0E-08	
96	3	28	7	53.00	21.0	95	95	48.00	9.10	93.55	5.0	3.4E-08	
96	3	28	13	0.00	21.0	95	95	49.15	10.30	92.50	6.7	3.2E-08	
96	3	29	9	6.00	21.0	95	95	51.70	14.30	88.70	2.6	3.0E-08	
96	3	29	13	33.00	22.0	95	95	52.65	15.05	87.95	0.0	2.7E-08	
96	3	29	15	40.00	22.0	95	95	52.85	15.45	87.65	14.3	2.7E-08	
96	4	1	7	34.00	21.0	95	95	59.10	24.15	79.40	2.7	2.6E-08	
96	4	1	15	9.00	22.0	95	95	60.15	25.00	78.65	6.3	2.3E-08	1
96	4	2	7	24.00	21.0	95	95	60.75	26.60	77.00	-1.5	2.3E-08	1
96	4	2	12	57.00	21.5	95	95	61.15	27.20	76.50	9.1	2.4E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
Termination determined by stable Kv and low flow differential 9.3E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

✓ JPH
4/3/96

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB 212, 29-31'

Date: 03-Apr-96
Tech: DEO
File: 394103A
Cell #: 10

Page:2 of 2

Visual Descript:Silty clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.86	Permeant: WATER	
Sample Ht. (in)	1.99	1.99	Permeant Specific Gravity:	1.00
Tare & Wet (g)	210.4	698.9	Sample Specific Gravity:	2.65 EST.
Tare & Dry (g)	196.0	627.1	Confining Pressure (psi):	100.0
Tare (g)	114.2	270.4	Burette Diameter (in):	0.250
Sample Wt. (g)	424.9	428.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	17.6	20.1	MAXIMUM GRADIENT:	15.7
WET DENS. (pcf)	127.5	127.7	AVERAGE GRADIENT:	13.4
DRY DENS. (pcf)	108.4	106.3	MAX. EFFECT. STRESS (psi):	6.0
SATURATION (%)	88.8	96.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.3

Date			Time		Temp		Press. (psi)		Readings (cm)			Flow Dif.		Kv **		Ave.
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP		%	cm/sec		0,1	
96	4	1	7	37.00	0.0	95	95	28.70	1.60	100.40						
96	4	1	7	53.00	21.0	95	95	28.60	6.60	95.15	-2.4		2.2E-06			
96	4	1	8	20.00	21.0	95	95	28.65	13.30	88.50	0.4		1.9E-06			
96	4	1	8	55.00	21.0	95	95	28.80	20.20	81.75	1.1		1.8E-06			
96	4	1	10	1.00	21.0	95	95	29.00	29.46	72.55	0.3		1.7E-06			
96	4	2	14	14.00	0.0	95	95	32.30	2.70	99.70						
96	4	2	14	33.00	21.0	95	95	32.20	6.60	95.55	-3.1		1.4E-06			
96	4	2	14	43.00	21.0	95	95	32.35	8.40	93.65	-2.7		1.3E-06			
96	4	2	15	0.00	21.0	95	95	32.20	11.35	90.70	-0.0		1.3E-06			
96	4	2	15	21.00	21.0	95	95	32.05	14.60	87.45	0.0		1.3E-06			1
96	4	2	15	39.00	21.0	95	95	32.05	17.25	84.85	1.0		1.3E-06			1
96	4	2	16	1.00	21.0	95	95	32.00	20.15	81.95	0.0		1.3E-06			1
96	4	2	16	20.00	21.0	95	95	32.10	22.50	79.60	-0.0		1.3E-06			1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 1.3E-06 cm/sec
Termination determined by stable Kv and low flow differential 5.1E-07 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

3.3 LABORATORY ANALYSIS

Soil samples which indicated VOC concentration greater than 8,000 ppm from the field GC analytical results, or PCB concentrations close to 10 ppm from the Ohmicron Rapid Assay Soil Field Test kit were sent to IEA Analytical Laboratories in Cary, North Carolina for confirmatory analyses in accordance with the Contract Laboratory Program (CLP) Statement of Work.

A summary of the analytical laboratory results and comparison to the field GC and PCB test kits are presented in Table 2. The complete IEA Laboratory report is presented in Appendix E.

3.4 GEOTECHNICAL LABORATORY ANALYSIS

Geotechnical laboratory analysis performed at CGC, Inc. of Madison, Wisconsin included: grain size distribution (ASTM D422) for granular, Atterberg limits (liquid limit and plasticity index) (ASTM D4318), grain size distribution (ASTM D422), and flexible-wall permeability tests (ASTM D5084) for samples from the clay confining layer. Rigid-wall falling head permeability testing was performed on four Shelby tube samples of the confining clay layer.

Geotechnical laboratory testing for the soil-bentonite mix design and compatibility testing was not performed at this time. As previously stated, these tests will be performed by our construction subcontractor, as necessary, to select a soil-bentonite mix for sections of the barrier wall to be constructed as a bentonite slurry wall.

Geotechnical analyses of selected soil samples were conducted in accordance with the Dewatering/Barrier Wall Alignment Pre-Design Work Plan, with the following exceptions:

- Soil samples collected for grain size analysis along the proposed final alignment were analyzed at intervals greater than 200 feet. Because the original 200-foot spacing of soil samples for grain size analysis was based on a shorter length of alignment, increasing the proposed alignment length served to extend the distance between samples. Due to the consistent geology over the entire site, little variation in grain size was noted between borings located more than 200 feet apart (see Section 7). Soil samples were collected from all borings conducted during the investigation and are currently being stored. These soil samples will be available for additional grain size analyses in the future, if necessary.
- A flexible-wall hydraulic conductivity/permeability test (ASTM D5084) was not performed on the one of the four clay confining layers samples (SB206) because there was insufficient volume of the undisturbed Shelby tube sample.
- In addition to the flexible-wall hydraulic conductivity/permeability testing, rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM

GEOTECHNICAL RESULTS

The geotechnical laboratory results performed on selected soil samples are summarized on Table 3. The laboratory reports are presented in Appendix F.

The granular soils above the clay confining layer are generally classified as a fine to coarse sand with a trace to some silt and clay, and have the Unified Soil Classification System (USCS) symbols of SP, SP-SM, and SM. The clay confining layer is generally classified as clay with a USCS symbol of CL

According to the rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM 1110-2-1906 (VII)), the permeability of the clay confining layer ranged from 1.7×10^{-8} cm/s (centimeters per second) to 2.4×10^{-8} cm/s based on relatively undisturbed Shelby tube samples. Liquid and plasticity limits ranged from 28-30% and 11-14%, respectively (Table 3).

The results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) for SB109 and SB151 show the permeability of the clay confining layer to be 2.0×10^{-8} cm/sec and 2.4×10^{-8} , respectively. These data are consistent with the permeability values calculated from the falling head method. The result for sample SB212, using the flexible wall method, is two orders of magnitude greater than the result from the falling head method (Table 3). The sample used for the flexible wall method was observed to be more silty than the sample used for the falling head method.

Table 3
Geotechnical Laboratory Results Summary
Barrier Wall Alignment Report
American Chemical Service, Inc.
Griffith, Indiana

Soil Boring Number	Sample Number	Coordinates		Sample Depth (ft)	Liquid Limit (%)	Plasticity Index (%)	Gravel Content (%)	Sand Content (%)	P200 Content (%)	USCS	Permeability	
		Northing	Easting								Rigid Wall (cm/s)	Flexible Wall (cm/s)
SB-212	SS4	5759	5454	7-9	NA	NA	0.0	86.9	13.1	SM	NA	NA
SB-212	SS9	5759	5454	17-19	NA	NA	5.5	87.1	7.4	SW-SM	NA	NA
SB-215	SS5	6126	5615	9-11	NA	NA	4.0	87.5	8.5	SP-SM	NA	NA
SB-215	SS10	6126	5615	19-21	NA	NA	19.8	76.5	3.7	SP	NA	NA
SB-217	SS4	6444	5603	7-9	NA	NA	32.4	62.1	5.5	SP-SM	NA	NA
SB-217	SS10	6444	5603	19-21	NA	NA	0.9	83.9	15.2	SM	NA	NA
SB-206	SS4	5856	5013	7-9	NA	NA	0.2	92.0	7.8	SP-SM	NA	NA
SB-206	SS7	5856	5013	13-15	NA	NA	0.0	90.9	9.1	SP-SM	NA	NA
SB-151	SS5	6764	5890	9-11	NA	NA	14.2	82.4	3.4	SP	NA	NA
SB-151	SS7	6764	5890	13-15	NA	NA	9.2	87.6	3.2	SP	NA	NA
SB-152	SS3	6607	5819	5-7	NA	NA	5.7	87.2	7.1	SP-SM	NA	NA
SB-152	SS10	6607	5819	19-21	NA	NA	11.5	76.3	12.2	SM	NA	NA
SB-221	SS2	6354	5138	3-5	NA	NA	0.0	90.5	9.5	SP-SM	NA	NA
SB-221	SS5	6354	5138	9-11	NA	NA	0.2	87.5	12.3	SM	NA	NA
SB-109	SS3	7027	5308	5-7	NA	NA	0.0	96.6	3.4	SP	NA	NA
SB-109	SS8	7027	5308	15-17	NA	NA	11.4	80.6	8.0	SP-SM	NA	NA
SB-136	SS2	6904	5146	3-5	NA	NA	2.0	93.0	5.0	SP-SM	NA	NA
SB-136	SS6	6904	5146	11-13	NA	NA	4.2	88.4	7.4	SP-SM	NA	NA
SB-113	SS5	7066	5422	9-11	NA	NA	0.5	92.3	7.2	SP-SM	NA	NA
SB-113	SS6	7066	5422	11-13	NA	NA	8.4	88.0	3.6	SP	NA	NA
SB-112	SS5	6935	5576	9-11	NA	NA	8.1	74.9	17.0	SM	NA	NA
SB-112	SS8	6935	5576	15-17	NA	NA	0.4	95.0	4.6	SP	NA	NA
SB-109	ST	7027	5308	19-21	30	14	1.9	7.9	90.2	CL	1.7E-08	2.0E-08
SB-151	ST	6764	5890	23-25	29	11	0.9	12.1	87.0	CL	2.0E-08	2.4E-08
SB-206	ST	5856	5013	25.5-27.5	28	12	3.3	14.3	82.4	CL	1.8E-08	NT
SB-212	ST	5759	5454	29-31	28	11	0.7	10	89.3	RP	2.4E-08	1.3E-06

Notes:

ST = Shelby tube sample

NA = Test not applicable to this sample

NT = Sample not tested because of insufficient volume of undisturbed material

J:\0770075\TABLE3.XLS

TAB3.tbl\LAB

4/19/96

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB109, 19-21'

Date: 03-Apr-96
Tech: DEO
File: 394101
Cell #: 8

Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

Sample Dia. (in)	INIT. 2.86	FINAL 2.86	Permeant: WATER
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity: 1.00
Tare & Wet (g)	200.5	616.0	Sample Specific Gravity: 2.70 EST.
Tare & Dry (g)	188.5	539.1	Confining Pressure (psi): 100.0
Tare (g)	114.5	87.2	Burette Diameter (in): 0.250
Sample Wt. (g)	528.5	528.8	Burette Zero (cm): 100.0

****CALCULATED VALUES****

MOISTURE (%)	16.2	17.0	MAXIMUM GRADIENT:	12.2
WET DENS. (pcf)	136.3	136.3	AVERAGE GRADIENT:	10.6
DRY DENS. (pcf)	117.3	116.5	MAX. EFFECT. STRESS (psi):	5.7
SATURATION (%)	100.2	103.0	MIN. EFFECT. STRESS (psi):	4.3
			AVE. EFFECT. STRESS (psi):	4.7

YY	MM	DD	Time HH	Temp MM	Co*	Press. (psi)		Readings (cm)			Flow Dif. %	Kv ** cm/sec	Ave. 0,1
						BOT	TOP	CHAM	BOT	TOP			
96	3	26	7	49.00	0.0	95	95	52.30	1.65	99.85			
96	3	26	8	40.00	20.0	95	95	52.75	1.80	99.50	-40.0	3.7E-08	
96	3	26	9	31.00	20.0	95	95	53.05	2.10	99.30	20.0	3.7E-08	
96	3	26	14	20.00	20.0	95	95	54.45	3.30	98.35	11.6	2.9E-08	
96	3	26	16	23.00	20.0	95	95	55.05	3.75	97.90	0.0	2.9E-08	
96	3	27	7	41.00	20.5	95	95	58.35	7.00	95.05	6.6	2.7E-08	
96	3	27	15	55.00	21.5	95	95	60.80	8.55	93.65	5.1	2.5E-08	
96	3	28	7	51.00	21.	95	95	62.60	11.30	91.30	7.8	2.3E-08	
96	3	28	13	1.00	21.0	95	95	63.75	12.15	90.60	9.7	2.3E-08	
96	3	29	9	7.00	21.0	95	95	66.30	15.00	87.90	2.7	2.2E-08	
96	3	29	13	32.00	22.0	95	95	67.35	15.55	87.35	-0.0	2.0E-08	
96	3	29	15	41.00	0.0	95	95	67.60	15.90	87.15			
96	4	1	7	33.00	21.0	95	95	72.75	23.20	80.50	4.7	2.1E-08	1
96	4	1	15	10.00	22.0	95	95	74.15	23.95	79.85	7.1	1.9E-08	1
96	4	2	7	23.00	21.0	95	95	74.40	25.40	78.35	-1.7	2.0E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.0E-08 cm/sec
Termination determined by stable Kv and low flow differential 7.9E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB151, 23-25'

Date: 03-Apr-96
Tech: DEO
File: 394102
Cell #: 9

Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

Sample Dia. (in)	INIT. 2.85	FINAL 2.85	Permeant: WATER
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity: 1.00
Tare & Wet (g)	211.4	598.5	Sample Specific Gravity: 2.70 EST.
Tare & Dry (g)	196.3	513.5	Confining Pressure (psi): 100.0
Tare (g)	116.1	84.0	Burette Diameter (in): 0.250
Sample Wt. (g)	513.0	514.5	Burette Zero (cm): 100.0

****CALCULATED VALUES****

MOISTURE (%)	18.9	19.8	MAXIMUM GRADIENT:	9.5
WET DENS. (pcf)	133.2	133.6	AVERAGE GRADIENT:	8.9
DRY DENS. (pcf)	112.0	111.5	MAX. EFFECT. STRESS (psi):	5.8
SATURATION (%)	101.2	104.6	MIN. EFFECT. STRESS (psi):	4.4
			AVE. EFFECT. STRESS (psi):	4.9

Date	Time	Temp	Press.(psi)	Readings (cm)	Flow Dif.	Kv **	Ave.
YY MM DD	HH	MM Co*	BOT TOP	CHAM BOT TOP	%	cm/sec	0,1
96 3 27	7	53.00 0.0	95 95	43.20 2.25 100.15			
96 3 27	8	29.00 20.5	95 95	43.10 2.50 99.65	-33.3	8.0E-08	
96 3 27	9	9.00 20.5	95 95	43.35 2.75 99.40	0.0	4.8E-08	
96 3 27	15	53.00 21.5	95 95	45.45 4.90 97.35	2.4	4.0E-08	
96 3 28	7	53.00 21.0	95 95	48.00 9.10 93.55	5.0	3.4E-08	
96 3 28	13	0.00 21.0	95 95	49.15 10.30 92.50	6.7	3.2E-08	
96 3 29	9	6.00 21.0	95 95	51.70 14.30 88.70	2.6	3.0E-08	
96 3 29	13	33.00 22.0	95 95	52.65 15.05 87.95	0.0	2.7E-08	
96 3 29	15	40.00 22.0	95 95	52.85 15.45 87.65	14.3	2.7E-08	
96 4 1	7	34.00 21.0	95 95	59.10 24.15 79.40	2.7	2.6E-08	
96 4 1	15	9.00 22.0	95 95	60.15 25.00 78.65	6.3	2.3E-08	1
96 4 2	7	24.00 21.0	95 95	60.75 26.60 77.00	-1.5	2.3E-08	1
96 4 2	12	57.00 21.5	95 95	61.15 27.20 76.50	9.1	2.4E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
Termination determined by stable Kv and low flow differential 9.3E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

1024
4/3/96

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB 212, 29-31'

Date: 03-Apr-96
Tech: DEO
File: 394103A
Cell #: 10

Page:2 of 2

Visual Descript:Silty clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.86	Permeant: WATER	
Sample Ht. (in)	1.99	1.99	Permeant Specific Gravity:	1.00
Tare & Wet (g)	210.4	698.9	Sample Specific Gravity:	2.65 EST.
Tare & Dry (g)	196.0	627.1	Confining Pressure (psi):	100.0
Tare (g)	114.2	270.4	Burette Diameter (in):	0.250
Sample Wt. (g)	424.9	428.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	17.6	20.1	MAXIMUM GRADIENT:	15.7
WET DENS. (pcf)	127.5	127.7	AVERAGE GRADIENT:	13.4
DRY DENS. (pcf)	108.4	106.3	MAX. EFFECT. STRESS (psi):	6.0
SATURATION (%)	88.8	96.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.3

Date	Time	Temp	Press.(psi)	Readings (cm)	Flow Dif.	Kv **	Ave.
YY MM DD	HH	MM Co*	BOT TOP	CHAM BOT TOP	%	cm/sec	0,1
96 4 1	7	37.00 0.0	95 95	28.70 1.60 100.40			
96 4 1	7	53.00 21.0	95 95	28.60 6.60 95.15	-2.4	2.2E-06	
96 4 1	8	20.00 21.0	95 95	28.65 13.30 88.50	0.4	1.9E-06	
96 4 1	8	55.00 21.0	95 95	28.80 20.20 81.75	1.1	1.8E-06	
96 4 1	10	1.00 21.0	95 95	29.00 29.46 72.55	0.3	1.7E-06	
96 4 2	14	14.00 0.0	95 95	32.30 2.70 99.70			
96 4 2	14	33.00 21.0	95 95	32.20 6.60 95.55	-3.1	1.4E-06	
96 4 2	14	43.00 21.0	95 95	32.35 8.40 93.65	-2.7	1.3E-06	
96 4 2	15	0.00 21.0	95 95	32.20 11.35 90.70	-0.0	1.3E-06	
96 4 2	15	21.00 21.0	95 95	32.05 14.60 87.45	0.0	1.3E-06	1
96 4 2	15	39.00 21.0	95 95	32.05 17.25 84.85	1.0	1.3E-06	1
96 4 2	16	1.00 21.0	95 95	32.00 20.15 81.95	0.0	1.3E-06	1
96 4 2	16	20.00 21.0	95 95	32.10 22.50 79.60	-0.0	1.3E-06	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 1.3E-06 cm/sec
Termination determined by stable Kv and low flow differential 5.1E-07 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

3.3 LABORATORY ANALYSIS

Soil samples which indicated VOC concentration greater than 8,000 ppm from the field GC analytical results, or PCB concentrations close to 10 ppm from the Ohmicron Rapid Assay Soil Field Test kit were sent to IEA Analytical Laboratories in Cary, North Carolina for confirmatory analyses in accordance with the Contract Laboratory Program (CLP) Statement of Work.

A summary of the analytical laboratory results and comparison to the field GC and PCB test kits are presented in Table 2. The complete IEA Laboratory report is presented in Appendix E.

3.4 GEOTECHNICAL LABORATORY ANALYSIS

Geotechnical laboratory analysis performed at CGC, Inc. of Madison, Wisconsin included: grain size distribution (ASTM D422) for granular, Atterberg limits (liquid limit and plasticity index) (ASTM D4318), grain size distribution (ASTM D422), and flexible-wall permeability tests (ASTM D5084) for samples from the clay confining layer. Rigid-wall falling head permeability testing was performed on four Shelby tube samples of the confining clay layer.

Geotechnical laboratory testing for the soil-bentonite mix design and compatibility testing was not performed at this time. As previously stated, these tests will be performed by our construction subcontractor, as necessary, to select a soil-bentonite mix for sections of the barrier wall to be constructed as a bentonite slurry wall.

Geotechnical analyses of selected soil samples were conducted in accordance with the Dewatering/Barrier Wall Alignment Pre-Design Work Plan, with the following exceptions:

- Soil samples collected for grain size analysis along the proposed final alignment were analyzed at intervals greater than 200 feet. Because the original 200-foot spacing of soil samples for grain size analysis was based on a shorter length of alignment, increasing the proposed alignment length served to extend the distance between samples. Due to the consistent geology over the entire site, little variation in grain size was noted between borings located more than 200 feet apart (see Section 7). Soil samples were collected from all borings conducted during the investigation and are currently being stored. These soil samples will be available for additional grain size analyses in the future, if necessary.
- A flexible-wall hydraulic conductivity/permeability test (ASTM D5084) was not performed on one of the four clay confining layers samples (SB206) because there was insufficient volume of the undisturbed Shelby tube sample.
- In addition to the flexible-wall hydraulic conductivity/permeability testing, rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM

GEOTECHNICAL RESULTS

The geotechnical laboratory results performed on selected soil samples are summarized on Table 3. The laboratory reports are presented in Appendix F.

The granular soils above the clay confining layer are generally classified as a fine to coarse sand with a trace to some silt and clay, and have the Unified Soil Classification System (USCS) symbols of SP, SP-SM, and SM. The clay confining layer is generally classified as clay with a USCS symbol of CL.

According to the rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM 1110-2-1906 (VII)), the permeability of the clay confining layer ranged from 1.7×10^{-8} cm/s (centimeters per second) to 2.4×10^{-8} cm/s based on relatively undisturbed Shelby tube samples. Liquid and plasticity limits ranged from 28-30% and 11-14%, respectively (Table 3).

The results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) for SB109 and SB151 show the permeability of the clay confining layer to be 2.0×10^{-8} cm/sec and 2.4×10^{-8} , respectively. These data are consistent with the permeability values calculated from the falling head method. The result for sample SB212, using the flexible wall method, is two orders of magnitude greater than the result from the falling head method (Table 3). The sample used for the flexible wall method was observed to be more silty than the sample used for the falling head method.

Table 3
Geotechnical Laboratory Results Summary
Barrier Wall Alignment Report
American Chemical Service, Inc.
Griffith, Indiana

Soil Boring Number	Sample Number	Coordinates		Sample Depth (ft)	Liquid Limit (%)	Plasticity Index (%)	Gravel Content (%)	Sand Content (%)	P200 Content (%)	USCS	Permeability	
		Northing	Easting								Rigid Wall (cm/s)	Flexible Wall (cm/s)
SB-212	SS4	5759	5454	7-9	NA	NA	0.0	86.9	13.1	SM	NA	NA
SB-212	SS9	5759	5454	17-19	NA	NA	5.5	87.1	7.4	SW-SM	NA	NA
SB-215	SS5	6126	5615	9-11	NA	NA	4.0	87.5	8.5	SP-SM	NA	NA
SB-215	SS10	6126	5615	19-21	NA	NA	19.8	76.5	3.7	SP	NA	NA
SB-217	SS4	6444	5603	7-9	NA	NA	32.4	62.1	5.5	SP-SM	NA	NA
SB-217	SS10	6444	5603	19-21	NA	NA	0.9	83.9	15.2	SM	NA	NA
SB-206	SS4	5856	5013	7-9	NA	NA	0.2	92.0	7.8	SP-SM	NA	NA
SB-206	SS7	5856	5013	13-15	NA	NA	0.0	90.9	9.1	SP-SM	NA	NA
SB-151	SS5	6764	5890	9-11	NA	NA	14.2	82.4	3.4	SP	NA	NA
SB-151	SS7	6764	5890	13-15	NA	NA	9.2	87.6	3.2	SP	NA	NA
SB-152	SS3	6607	5819	5-7	NA	NA	5.7	87.2	7.1	SP-SM	NA	NA
SB-152	SS10	6607	5819	19-21	NA	NA	11.5	76.3	12.2	SM	NA	NA
SB-221	SS2	6354	5138	3-5	NA	NA	0.0	90.5	9.5	SP-SM	NA	NA
SB-221	SS5	6354	5138	9-11	NA	NA	0.2	87.5	12.3	SM	NA	NA
SB-109	SS3	7027	5308	5-7	NA	NA	0.0	96.6	3.4	SP	NA	NA
SB-109	SS8	7027	5308	15-17	NA	NA	11.4	80.6	8.0	SP-SM	NA	NA
SB-136	SS2	6904	5146	3-5	NA	NA	2.0	93.0	5.0	SP-SM	NA	NA
SB-136	SS6	6904	5146	11-13	NA	NA	4.2	88.4	7.4	SP-SM	NA	NA
SB-113	SS5	7066	5422	9-11	NA	NA	0.5	92.3	7.2	SP-SM	NA	NA
SB-113	SS6	7066	5422	11-13	NA	NA	8.4	88.0	3.6	SP	NA	NA
SB-112	SS5	6935	5576	9-11	NA	NA	8.1	74.9	17.0	SM	NA	NA
SB-112	SS8	6935	5576	15-17	NA	NA	0.4	95.0	4.6	SP	NA	NA
SB-109	ST	7027	5308	19-21	30	14	1.9	7.9	90.2	CL	1.7E-08	2.0E-08
SB-151	ST	6764	5890	23-25	29	11	0.9	12.1	87.0	CL	2.0E-08	2.4E-08
SB-206	ST	5856	5013	25.5-27.5	28	12	3.3	14.3	82.4	CL	1.8E-08	NT
SB-212	ST	5759	5454	29-31	28	11	0.7	10	89.3	RP	2.4E-08	1.3E-06

Notes:

ST = Shelby tube sample

NA = Test not applicable to this sample

NT = Sample not tested because of insufficient volume of undisturbed material

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB109, 19-21'

Date: 03-Apr-96
Tech: DEO
File: 394101
Cell #: 8

Page:1 of 1

Visual Descript:Lean clay

INPUT VALUES

	INIT.	FINAL		Permeant: WATER	
Sample Dia. (in)	2.86	2.86			
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	200.5	616.0	Sample Specific Gravity:	2.70	EST.
Tare & Dry (g)	188.5	539.1	Confining Pressure (psi):	100.0	
Tare (g)	114.5	87.2	Burette Diameter (in):	0.250	
Sample Wt. (g)	528.5	528.8	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	16.2	17.0	MAXIMUM GRADIENT:	12.2
WET DENS. (pcf)	136.3	136.3	AVERAGE GRADIENT:	10.6
DRY DENS. (pcf)	117.3	116.5	MAX. EFFECT. STRESS (psi):	5.7
SATURATION (%)	100.2	103.0	MIN. EFFECT. STRESS (psi):	4.3
			AVE. EFFECT. STRESS (psi):	4.7

Date		Time		Temp		Press.(psi)		Readings (cm)			Flow Dif.	Kv **	Ave.
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	3	26	7	49.00	0.0	95	95	52.30	1.65	99.85			
96	3	26	8	40.00	20.0	95	95	52.75	1.80	99.50	-40.0	3.7E-08	
96	3	26	9	31.00	20.0	95	95	53.05	2.10	99.30	20.0	3.7E-08	
96	3	26	14	20.00	20.0	95	95	54.45	3.30	98.35	11.6	2.9E-08	
96	3	26	16	23.00	20.0	95	95	55.05	3.75	97.90	0.0	2.9E-08	
96	3	27	7	41.00	20.5	95	95	58.35	7.00	95.05	6.6	2.7E-08	
96	3	27	15	55.00	21.5	95	95	60.80	8.55	93.65	5.1	2.5E-08	
96	3	28	7	51.00	21.0	95	95	62.60	11.30	91.30	7.8	2.3E-08	
96	3	28	13	1.00	21.0	95	95	63.75	12.15	90.60	9.7	2.3E-08	
96	3	29	9	7.00	21.0	95	95	66.30	15.00	87.90	2.7	2.2E-08	
96	3	29	13	32.00	22.0	95	95	67.35	15.55	87.35	-0.0	2.0E-08	
96	3	29	15	41.00	0.0	95	95	67.60	15.90	87.15			
96	4	1	7	33.00	21.0	95	95	72.75	23.20	80.50	4.7	2.1E-08	1
96	4	1	15	10.00	22.0	95	95	74.15	23.95	79.85	7.1	1.9E-08	1
96	4	2	7	23.00	21.0	95	95	74.40	25.40	78.35	-1.7	2.0E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.0E-08 cm/sec
Termination determined by stable Kv and low flow differential 7.9E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB151, 23-25'

Date: 03-Apr-96
Tech: DEO
File: 394102
Cell #: 9

Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.85	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	211.4	598.5	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	196.3	513.5	Confining Pressure (psi):	100.0
Tare (g)	116.1	84.0	Burette Diameter (in):	0.250
Sample Wt. (g)	513.0	514.5	Burette Zero (cm):	100.0

****CALCULATED VALUES****

MOISTURE (%)	18.9	19.8	MAXIMUM GRADIENT:	9.5
WET DENS. (pcf)	133.2	133.6	AVERAGE GRADIENT:	8.9
DRY DENS. (pcf)	112.0	111.5	MAX. EFFECT. STRESS (psi):	5.8
SATURATION (%)	101.2	104.6	MIN. EFFECT. STRESS (psi):	4.4
			AVE. EFFECT. STRESS (psi):	4.9

Date	Time	Temp	Press.(psi)	Readings (cm)	Flow Dif.	Kv **	Ave.
YY MM DD	HH	MM Co*	BOT TOP	CHAM BOT TOP	%	cm/sec	0,1
96	3 27	7 53.00 0.0	95 95	43.20 2.25 100.15			
96	3 27	8 29.00 20.5	95 95	43.10 2.50 99.65	-33.3	8.0E-08	
96	3 27	9 9.00 20.5	95 95	43.35 2.75 99.40	0.0	4.8E-08	
96	3 27	15 53.00 21.5	95 95	45.45 4.90 97.35	2.4	4.0E-08	
96	3 28	7 53.00 21.0	95 95	48.00 9.10 93.55	5.0	3.4E-08	
96	3 28	13 0.00 21.0	95 95	49.15 10.30 92.50	6.7	3.2E-08	
96	3 29	9 6.00 21.0	95 95	51.70 14.30 88.70	2.6	3.0E-08	
96	3 29	13 33.00 22.0	95 95	52.65 15.05 87.95	0.0	2.7E-08	
96	3 29	15 40.00 22.0	95 95	52.85 15.45 87.65	14.3	2.7E-08	
96	4 1	7 34.00 21.0	95 95	59.10 24.15 79.40	2.7	2.6E-08	
96	4 1	15 9.00 22.0	95 95	60.15 25.00 78.65	6.3	2.3E-08	1
96	4 2	7 24.00 21.0	95 95	60.75 26.60 77.00	-1.5	2.3E-08*	1
96	4 2	12 57.00 21.5	95 95	61.15 27.20 76.50	9.1	2.4E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
Termination determined by stable Kv and low flow differential 9.3E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

JPH
4/3/96

Falling Head Permeability Test
(Version 1.02)

Project: CGC, Inc.
Project #: 3941.01
Sample: SB 212, 29-31'

Date: 03-Apr-96
Tech: DEO
File: 394103A
Cell #: 10
Page: 2 of 2

Visual Descript: Silty clay

INPUT VALUES

	INIT.	FINAL		Permeant: WATER
Sample Dia. (in)	2.85	2.86		
Sample Ht. (in)	1.99	1.99	Permeant Specific Gravity:	1.00
Tare & Wet (g)	210.4	698.9	Sample Specific Gravity:	2.65 EST.
Tare & Dry (g)	196.0	627.1	Confining Pressure (psi):	100.0
Tare (g)	114.2	270.4	Burette Diameter (in):	0.250
Sample Wt. (g)	424.9	428.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	17.6	20.1	MAXIMUM GRADIENT:	15.7
WET DENS. (pcf)	127.5	127.7	AVERAGE GRADIENT:	13.4
DRY DENS. (pcf)	108.4	106.3	MAX. EFFECT. STRESS (psi):	6.0
SATURATION (%)	88.8	96.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.3

Date		Time	Temp	Press. (psi)	Readings (cm)			Flow Dif.	Kv **	Ave.			
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	4	1	7	37.00	0.0	95	95	28.70	1.60	100.40			
96	4	1	7	53.00	21.0	95	95	28.60	6.60	95.15	-2.4	2.2E-06	
96	4	1	8	20.00	21.0	95	95	28.65	13.30	88.50	0.4	1.9E-06	
96	4	1	8	55.00	21.0	95	95	28.80	20.20	81.75	1.1	1.8E-06	
96	4	1	10	1.00	21.0	95	95	29.00	29.46	72.55	0.3	1.7E-06	
96	4	2	14	14.00	0.0	95	95	32.30	2.70	99.70			
96	4	2	14	33.00	21.0	95	95	32.20	6.60	95.55	-3.1	1.4E-06	
96	4	2	14	43.00	21.0	95	95	32.35	8.40	93.65	-2.7	1.3E-06	
96	4	2	15	0.00	21.0	95	95	32.20	11.35	90.70	-0.0	1.3E-06	
96	4	2	15	21.00	21.0	95	95	32.05	14.60	87.45	0.0	1.3E-06	1
96	4	2	15	39.00	21.0	95	95	32.05	17.25	84.85	1.0	1.3E-06	1
96	4	2	16	1.00	21.0	95	95	32.00	20.15	81.95	0.0	1.3E-06	1
96	4	2	16	20.00	21.0	95	95	32.10	22.50	79.60	-0.0	1.3E-06	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

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Termination determined by stable Kv and low flow differential 5.1E-07 in/sec
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3.3 LABORATORY ANALYSIS

Soil samples which indicated VOC concentration greater than 8,000 ppm from the field GC analytical results, or PCB concentrations close to 10 ppm from the Ohmicron Rapid Assay Soil Field Test kit were sent to IEA Analytical Laboratories in Cary, North Carolina for confirmatory analyses in accordance with the Contract Laboratory Program (CLP) Statement of Work.

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Geotechnical laboratory testing for the soil-bentonite mix design and compatibility testing was not performed at this time. As previously stated, these tests will be performed by our construction subcontractor, as necessary, to select a soil-bentonite mix for sections of the barrier wall to be constructed as a bentonite slurry wall.

Geotechnical analyses of selected soil samples were conducted in accordance with the Dewatering/Barrier Wall Alignment Pre-Design Work Plan, with the following exceptions:

- Soil samples collected for grain size analysis along the proposed final alignment were analyzed at intervals greater than 200 feet. Because the original 200-foot spacing of soil samples for grain size analysis was based on a shorter length of alignment, increasing the proposed alignment length served to extend the distance between samples. Due to the consistent geology over the entire site, little variation in grain size was noted between borings located more than 200 feet apart (see Section 7). Soil samples were collected from all borings conducted during the investigation and are currently being stored. These soil samples will be available for additional grain size analyses in the future, if necessary.
- A flexible-wall hydraulic conductivity/permeability test (ASTM D5084) was not performed on one of the four clay confining layers samples (SB206) because there was insufficient volume of the undisturbed Shelby tube sample.
- In addition to the flexible-wall hydraulic conductivity/permeability testing, rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM

GEOTECHNICAL RESULTS

The geotechnical laboratory results performed on selected soil samples are summarized on Table 3. The laboratory reports are presented in Appendix F.

The granular soils above the clay confining layer are generally classified as a fine to coarse sand with a trace to some silt and clay, and have the Unified Soil Classification System (USCS) symbols of SP, SP-SM, and SM. The clay confining layer is generally classified as clay with a USCS symbol of CL

According to the rigid-wall falling head permeability testing (U.S. Army Corps of Engineers Method EM 1110-2-1906 (VII)), the permeability of the clay confining layer ranged from 1.7×10^{-8} cm/s (centimeters per second) to 2.4×10^{-8} cm/s based on relatively undisturbed Shelby tube samples. Liquid and plasticity limits ranged from 28-30% and 11-14%, respectively (Table 3).

The results of the flexible-wall hydraulic conductivity/permeability tests (ASTM D5084) for SB109 and SB151 show the permeability of the clay confining layer to be 2.0×10^{-8} cm/sec and 2.4×10^{-8} , respectively. These data are consistent with the permeability values calculated from the falling head method. The result for sample SB212, using the flexible wall method, is two orders of magnitude greater than the result from the falling head method (Table 3). The sample used for the flexible wall method was observed to be more silty than the sample used for the falling head method.

Table 3
Geotechnical Laboratory Results Summary
Barrier Wall Alignment Report
American Chemical Service, Inc.
Griffith, Indiana

Soil Boring Number	Sample Number	Coordinates		Sample Depth (ft)	Liquid Limit (%)	Plasticity Index (%)	Gravel Content (%)	Sand Content (%)	P200 Content (%)	USCS	Permeability	
		Northing	Easting								Rigid Wall (cm/s)	Flexible Wall (cm/s)
SB-212	SS4	5759	5454	7-9	NA	NA	0.0	86.9	13.1	SM	NA	NA
SB-212	SS9	5759	5454	17-19	NA	NA	5.5	87.1	7.4	SW-SM	NA	NA
SB-215	SS5	6126	5615	9-11	NA	NA	4.0	87.5	8.5	SP-SM	NA	NA
SB-215	SS10	6126	5615	19-21	NA	NA	19.8	76.5	3.7	SP	NA	NA
SB-217	SS4	6444	5603	7-9	NA	NA	32.4	62.1	5.5	SP-SM	NA	NA
SB-217	SS10	6444	5603	19-21	NA	NA	0.9	83.9	15.2	SM	NA	NA
SB-206	SS4	5856	5013	7-9	NA	NA	0.2	92.0	7.8	SP-SM	NA	NA
SB-206	SS7	5856	5013	13-15	NA	NA	0.0	90.9	9.1	SP-SM	NA	NA
SB-151	SS5	6764	5890	9-11	NA	NA	14.2	82.4	3.4	SP	NA	NA
SB-151	SS7	6764	5890	13-15	NA	NA	9.2	87.6	3.2	SP	NA	NA
SB-152	SS3	6607	5819	5-7	NA	NA	5.7	87.2	7.1	SP-SM	NA	NA
SB-152	SS10	6607	5819	19-21	NA	NA	11.5	76.3	12.2	SM	NA	NA
SB-221	SS2	6354	5138	3-5	NA	NA	0.0	90.5	9.5	SP-SM	NA	NA
SB-221	SS5	6354	5138	9-11	NA	NA	0.2	87.5	12.3	SM	NA	NA
SB-109	SS3	7027	5308	5-7	NA	NA	0.0	96.6	3.4	SP	NA	NA
SB-109	SS8	7027	5308	15-17	NA	NA	11.4	80.6	8.0	SP-SM	NA	NA
SB-136	SS2	6904	5146	3-5	NA	NA	2.0	93.0	5.0	SP-SM	NA	NA
SB-136	SS6	6904	5146	11-13	NA	NA	4.2	88.4	7.4	SP-SM	NA	NA
SB-113	SS5	7066	5422	9-11	NA	NA	0.5	92.3	7.2	SP-SM	NA	NA
SB-113	SS6	7066	5422	11-13	NA	NA	8.4	88.0	3.6	SP	NA	NA
SB-112	SS5	6935	5576	9-11	NA	NA	8.1	74.9	17.0	SM	NA	NA
SB-112	SS8	6935	5576	15-17	NA	NA	0.4	95.0	4.6	SP	NA	NA
SB-109	ST	7027	5308	19-21	30	14	1.9	7.9	90.2	CL	1.7E-08	2.0E-08
SB-151	ST	6764	5890	23-25	29	11	0.9	12.1	87.0	CL	2.0E-08	2.4E-08
SB-206	ST	5856	5013	25.5-27.5	28	12	3.3	14.3	82.4	CL	1.8E-08	NT
SB-212	ST	5759	5454	29-31	28	11	0.7	10	89.3	RP	2.4E-08	1.3E-06

Notes:

ST = Shelby tube sample

NA = Test not applicable to this sample

NT = Sample not tested because of insufficient volume of undisturbed material

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB109, 19-21'

Date: 03-Apr-96
Tech: DEO
File: 394101
Cell #: 8
Page:1 of 1

Visual Descript:Lean clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.86	2.86	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	200.5	616.0	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	188.5	539.1	Confining Pressure (psi):	100.0
Tare (g)	114.5	87.2	Burette Diameter (in):	0.250
Sample Wt. (g)	528.5	528.8	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	16.2	17.0	MAXIMUM GRADIENT:	12.2
WET DENS. (pcf)	136.3	136.3	AVERAGE GRADIENT:	10.6
DRY DENS. (pcf)	117.3	116.5	MAX. EFFECT. STRESS (psi):	5.7
SATURATION (%)	100.2	103.0	MIN. EFFECT. STRESS (psi):	4.3
			AVE. EFFECT. STRESS (psi):	4.7

YY	MM	DD	HH	Temp		Press.(psi)		Readings (cm)			Flow Dif. %	Kv ** cm/sec	Ave. 0,1
				MM	Co*	BOT	TOP	CHAM	BOT	TOP			
96	3	26	7	49.00	0.0	95	95	52.30	1.65	99.85			
96	3	26	8	40.00	20.0	95	95	52.75	1.80	99.50	-40.0	3.7E-08	
96	3	26	9	31.00	20.0	95	95	53.05	2.10	99.30	20.0	3.7E-08	
96	3	26	14	20.00	20.0	95	95	54.45	3.30	98.35	11.6	2.9E-08	
96	3	26	16	23.00	20.0	95	95	55.05	3.75	97.90	0.0	2.9E-08	
96	3	27	7	41.00	20.5	95	95	58.35	7.00	95.05	6.6	2.7E-08	
96	3	27	15	55.00	21.5	95	95	60.80	8.55	93.65	5.1	2.5E-08	
96	3	28	7	51.00	21.7	95	95	62.60	11.30	91.30	7.8	2.3E-08	
96	3	28	13	1.00	21.0	95	95	63.75	12.15	90.60	9.7	2.3E-08	
96	3	29	9	7.00	21.0	95	95	66.30	15.00	87.90	2.7	2.2E-08	
96	3	29	13	32.00	22.0	95	95	67.35	15.55	87.35	-0.0	2.0E-08	
96	3	29	15	41.00	0.0	95	95	67.60	15.90	87.15			
96	4	1	7	33.00	21.0	95	95	72.75	23.20	80.50	4.7	2.1E-08	1
96	4	1	15	10.00	22.0	95	95	74.15	23.95	79.85	7.1	1.9E-08	1
96	4	2	7	23.00	21.0	95	95	74.40	25.40	78.35	-1.7	2.0E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.0E-08 cm/sec
Termination determined by stable Kv and low flow differential 7.9E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB151, 23-25'

Date: 03-Apr-96
Tech: DEO
File: 394102
Cell #: 9

Page:1 of 1

Visual Descript:Lean clay

****INPUT VALUES****

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.85	Permeant: WATER	
Sample Ht. (in)	2.30	2.30	Permeant Specific Gravity:	1.00
Tare & Wet (g)	211.4	598.5	Sample Specific Gravity:	2.70 EST.
Tare & Dry (g)	196.3	513.5	Confining Pressure (psi):	100.0
Tare (g)	116.1	84.0	Burette Diameter (in):	0.250
Sample Wt. (g)	513.0	514.5	Burette Zero (cm):	100.0

****CALCULATED VALUES****

MOISTURE (%)	18.9	19.8	MAXIMUM GRADIENT:	9.5
WET DENS. (pcf)	133.2	133.6	AVERAGE GRADIENT:	8.9
DRY DENS. (pcf)	112.0	111.5	MAX. EFFECT. STRESS (psi):	5.8
SATURATION (%)	101.2	104.6	MIN. EFFECT. STRESS (psi):	4.4
			AVE. EFFECT. STRESS (psi):	4.9

Date	Time	Temp	Press.(psi)	Readings (cm)	Flow Dif.	Kv **	Ave.
YY MM DD	HH	MM Co*	BOT TOP	CHAM BOT TOP	%	cm/sec	0,1
96 3 27	7	53.00 0.0	95 95	43.20 2.25 100.15			
96 3 27	8	29.00 20.5	95 95	43.10 2.50 99.65	-33.3	8.0E-08	
96 3 27	9	9.00 20.5	95 95	43.35 2.75 99.40	0.0	4.8E-08	
96 3 27	15	53.00 21.5	95 95	45.45 4.90 97.35	2.4	4.0E-08	
96 3 28	7	53.00 21.0	95 95	48.00 9.10 93.55	5.0	3.4E-08	
96 3 28	13	0.00 21.0	95 95	49.15 10.30 92.50	6.7	3.2E-08	
96 3 29	9	6.00 21.0	95 95	51.70 14.30 88.70	2.6	3.0E-08	
96 3 29	13	33.00 22.0	95 95	52.65 15.05 87.95	0.0	2.7E-08	
96 3 29	15	40.00 22.0	95 95	52.85 15.45 87.65	14.3	2.7E-08	
96 4 1	7	34.00 21.0	95 95	59.10 24.15 79.40	2.7	2.6E-08	
96 4 1	15	9.00 22.0	95 95	60.15 25.00 78.65	6.3	2.3E-08	1
96 4 2	7	24.00 21.0	95 95	60.75 26.60 77.00	-1.5	2.3E-08	1
96 4 2	12	57.00 21.5	95 95	61.15 27.20 76.50	9.1	2.4E-08	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
Termination determined by stable Kv and low flow differential 9.3E-09 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature

JPH
4/3/96

Falling Head Permeability Test
(Version 1.02)

Project:CGC, Inc.
Project #:3941.01
Sample:SB 212, 29-31'

Date: 03-Apr-96
Tech: DEO
File: 394103A
Cell #: 10

Page:2 of 2

Visual Descript:Silty clay

INPUT VALUES

	INIT.	FINAL		
Sample Dia. (in)	2.85	2.86	Permeant: WATER	
Sample Ht. (in)	1.99	1.99	Permeant Specific Gravity:	1.00
Tare & Wet (g)	210.4	698.9	Sample Specific Gravity:	2.65 EST.
Tare & Dry (g)	196.0	627.1	Confining Pressure (psi):	100.0
Tare (g)	114.2	270.4	Burette Diameter (in):	0.250
Sample Wt. (g)	424.9	428.5	Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	17.6	20.1	MAXIMUM GRADIENT:	15.7
WET DENS. (pcf)	127.5	127.7	AVERAGE GRADIENT:	13.4
DRY DENS. (pcf)	108.4	106.3	MAX. EFFECT. STRESS (psi):	6.0
SATURATION (%)	88.8	96.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.3

Date		Time		Temp		Press.(psi)		Readings (cm)			Flow Dif.	Kv **	Ave.
YY	MM	DD	HH	MM	Co*	BOT	TOP	CHAM	BOT	TOP	%	cm/sec	0,1
96	4	1	7	37.00	0.0	95	95	28.70	1.60	100.40			
96	4	1	7	53.00	21.0	95	95	28.60	6.60	95.15	-2.4	2.2E-06	
96	4	1	8	20.00	21.0	95	95	28.65	13.30	88.50	0.4	1.9E-06	
96	4	1	8	55.00	21.0	95	95	28.80	20.20	81.75	1.1	1.8E-06	
96	4	1	10	1.00	21.0	95	95	29.00	29.46	72.55	0.3	1.7E-06	
96	4	2	14	14.00	0.0	95	95	32.30	2.70	99.70			
96	4	2	14	33.00	21.0	95	95	32.20	6.60	95.55	-3.1	1.4E-06	
96	4	2	14	43.00	21.0	95	95	32.35	8.40	93.65	-2.7	1.3E-06	
96	4	2	15	0.00	21.0	95	95	32.20	11.35	90.70	-0.0	1.3E-06	
96	4	2	15	21.00	21.0	95	95	32.05	14.60	87.45	0.0	1.3E-06	1
96	4	2	15	39.00	21.0	95	95	32.05	17.25	84.85	1.0	1.3E-06	1
96	4	2	16	1.00	21.0	95	95	32.00	20.15	81.95	0.0	1.3E-06	1
96	4	2	16	20.00	21.0	95	95	32.10	22.50	79.60	-0.0	1.3E-06	1

NOTES or COMMENTS :

Evaluated by: ASTM D5084

Average Kv for those rows with a 1 in the Ave. column 1.3E-06 cm/sec
Termination determined by stable Kv and low flow differential 5.1E-07 in/sec
* A zero in this column starts a series of measurements
** Kv adjusted for temperature



200942

TECHNICAL MEMORANDUM
UPPER AQUIFER INVESTIGATION
MONITORING WELL AND SAMPLING
PROPOSAL
(REVISED MAY 3, 1996)

AMERICAN CHEMICAL SERVICE, INC.
NPL SITE
GRIFFITH, INDIANA

PREPARED FOR:
ACS RD/RA EXECUTIVE COMMITTEE

...
PREPARED BY:
MONTGOMERY WATSON
ADDISON, ILLINOIS

MAY 1996



MONTGOMERY WATSON



MONTGOMERY WATSON

May 3, 1996

Ms. Sheri L. Bianchin
Remedial Project Manager
Superfund Division
United States Environmental Protection Agency
77 West Jackson Boulevard
Chicago, Illinois 60604

Re: Upper Aquifer Investigation Technical Memorandum
Response to Disapproval and Comments

Dear Ms. Bianchin:

This letter is written in response to your letter entitled "Disapproval of Upper Aquifer Investigation Technical Memorandum; American Chemical Service, Inc., NPL Superfund Site Griffith, Indiana" dated April 10, 1996, as well as your April 29, 1996 Clarification or Disapproval of March 1996 - Upper Aquifer Technical Memorandum letter. As we discussed with you in several calls and meetings, both before and after receipt of your April 10 letter, the ACS Site RD/RA Executive Committee does not agree with many of the assertions made in that document. ~~Nor do we agree with statements made in your April 29th clarification letter.~~ As we indicated at our April 23, 1996 meeting, we believe that it is ~~essential for our group and Agency management to meet as soon as possible to discuss these and other issues related to the ACS Site.~~ It is imperative that we meet prior to the installation of these wells.

~~Despite our basic disagreements,~~ we have developed and are submitting responses to each of your comments on our Upper Aquifer Investigation Technical Memorandum, as well as a revised Technical Memorandum with this letter. We have incorporated responses to your comments in our revised Technical Memorandum which includes installation of several monitoring wells and piezometers which we consider unnecessary for remedial design purposes and for the understanding of the hydrogeology of the site. As stated in more detail in our responses to you, comments, we are acquiescing in installing those additional wells and piezometers only because you have ordered us to do so and threatened enforcement action. We continue to believe that the identified wells and piezometers are without sound technical basis.

Before turning to your individual comments, we believe it is also important to again place the original purpose and intent of the Upper Aquifer Investigation Technical Memorandum in perspective. As you are aware, the Upper Aquifer Investigation Technical Memorandum was to be an account of the Upper Aquifer Investigation (Tracer Study) methods and results, and recommendations for upper aquifer well placement, as appropriate. The Technical Memorandum was not intended to be an exhaustive or all-inclusive review of the hydrogeology at the Site. This simplified technical memorandum concept was discussed with EPA and IDEM as part of the Pre-Design Work Plan approval process and is reflected in the approved Work Plan and Schedule. The technical memorandum approach was adopted for the upper aquifer and other aspects of the pre-design studies as a means of expediting completion of that work.

certain wells and piezometers that we believe are unnecessary. Our positions are reflected in our comment responses. Our purpose in providing the revised Technical Memorandum is to allow this project to proceed without further delay. However, our revisions should not be construed as reflecting agreement with all of EPA's asserted positions. Once you have had an opportunity to review these responses and the revised Technical Memorandum, we believe that the meeting between the Group and U.S. EPA/IDEM would be the appropriate forum for continuing the discussion on these items.

We suggest that the meeting with the agencies be scheduled as soon as possible. We are available to meet on May 16th or May 21st at 1:00. Please call and let us know which of those dates is preferable as soon as possible.

Responses to Comments

The following is a transcription of the March 15, 1996 U.S. EPA comments on the Upper Aquifer Technical Memorandum, with responses included.

ENCLOSURE

Review Comments

Upper Aquifer Investigation Technical Memorandum, March 15, 1996
American Chemical Services, Inc.
Superfund Site, Griffith, Indiana

GENERAL COMMENTS

1. There is a tendency to overstate the significance of the results of the field screening results. While the results are meaningful, it is important to realize the limitations of the data since it is only screening level data. The intent of the screening-investigation was to obtain an inference of the plume(s) boundaries; these inferences must be verified subsequently with the installation and sampling of a monitoring network. Hence, rewrite the text to 1) explain the goals served by the upper aquifer investigation; 2) explain the data including the data limitations; 3) provide reasonable conclusions along with rationales; and 4) provide recommendations and proposals along with the corresponding rationales.

In response to U.S. EPA's requirements, Montgomery Watson developed detailed SOPs for collecting the upper aquifer samples and for operation and QA/QC of the field gas chromatograph (GC). The SOPs were followed fully, and resulted in useful data. The GC field screening was used appropriately. The conclusions developed in the Technical Memorandum are not based solely on these results. The field screening played a supplemental role in developing the extent of contamination.

The text in the Technical Memorandum already accomplishes the numbered items at the



MONTGOMERY WATSON

May 3, 1996

Ms. Sheri L. Bianchin
Remedial Project Manager
Superfund Division
United States Environmental Protection Agency
77 West Jackson Boulevard
Chicago, Illinois 60604

**Re: Upper Aquifer Investigation Technical Memorandum
Response to Disapproval and Comments**

Dear Ms. Bianchin:

This letter is written in response to your letter entitled "Disapproval of Upper Aquifer Investigation Technical Memorandum; American Chemical Service, Inc., NPL Superfund Site, Griffith, Indiana" dated April 10, 1996, as well as your April 29, 1996 Clarification of Disapproval of March 1996 - Upper Aquifer Technical Memorandum letter. As we discussed with you in several calls and meetings, both before and after receipt of your April 10 letter, the ACS Site RD/RA Executive Committee does not agree with many of the assertions made in that document. Nor do we agree with statements made in your April 29th clarification letter. As we indicated at our April 23, 1996 meeting, we believe that it is essential for our group and Agency management to meet as soon as possible to discuss these and other issues related to the ACS Site. It is imperative that we meet prior to the installation of these wells.

Despite our basic disagreements, we have developed and are submitting responses to each of your comments on our Upper Aquifer Investigation Technical Memorandum, as well as a revised Technical Memorandum with this letter. We have incorporated responses to your comments in our revised Technical Memorandum which includes installation of several monitoring wells and piezometers which we consider unnecessary for remedial design purposes and for the understanding of the hydrogeology of the site. As stated in more detail in our responses to your comments, we are acquiescing in installing those additional wells and piezometers only because you have ordered us to do so and threatened enforcement action. We continue to believe that the identified wells and piezometers are without sound technical basis.

Before turning to your individual comments, we believe it is also important to again place the original purpose and intent of the Upper Aquifer Investigation Technical Memorandum in perspective. As you are aware, the Upper Aquifer Investigation Technical Memorandum was to be an account of the Upper Aquifer Investigation (Tracer Study) methods and results, and recommendations for upper aquifer well placement, as appropriate. The Technical Memorandum was not intended to be an exhaustive or all-inclusive review of the hydrogeology at the Site. This simplified technical memorandum concept was discussed with EPA and IDEM as part of the Pre-Design Work Plan approval process and is reflected in the approved Work Plan and Schedule. The technical memorandum approach was adopted for the upper aquifer and other aspects of the pre-design studies as a means of expediting completion of that work.

As part of the discussions on the Upper Aquifer Technical Memorandum, you have raised a question as to whether the Remedial Investigation (RI) was completed for the ACS Site. Apparently, you believe that the ongoing pre-design studies should be expansive enough to fill in an 'incomplete RI'. However, EPA has long considered the ACS Site RI to have been completed. In the ROD at page 5, EPA states that the RI/FS was **completed** in 1992. In the Unilateral Order, EPA again found that the RI/FS was "**concluded**" in 1992. The Agency, in fact, issued its ROD in direct reliance on the completed RI/FS. Based on these clear statements of Agency position, the RI must be viewed as done, and the pre-design studies should be allowed to proceed with the goal of developing information still needed for the final remedial design for the ACS Site.

It is also important to note that, as explained in the Technical Meeting of April 23, 1996, the results of the Upper Aquifer Investigation confirm the findings of the RI. The upper aquifer conditions at the ACS Site today are entirely consistent with our findings of 1989 and 1990 and monitoring since that time. Nothing in the latest investigatory findings would lead to a conclusion that something had been overlooked or missed during the RI so that additional upper aquifer nature and extent work would be necessary at or around the ACS Site.

In your clarification letter, you state that the Technical Committee did not believe that any confirmatory wells were necessary. This is an incorrect statement of the position taken by our Group. As stated in the original Technical Memorandum and the April 23 meeting, we were and remain willing to install new wells at the ACS Site. In our original Technical Memorandum results (page 10 and Figure 5), we proposed to install six new monitoring wells based on the Tracer Study. During the April 23rd meeting, in response to questions raised by the Agency, we proposed to install three more wells in addition to six proposed in the Technical Memorandum. As noted in the opening to this letter, in our revised Technical Memorandum, we have indicated that we will add wells and piezometers at the locations ordered by EPA. However, as explained during the April 23rd meeting and in our responses to comments, we continue to believe that certain of those wells and the piezometers are not needed for remedial design purposes. We are installing those wells and piezometers in direct response to your threat of enforcement action, rather than because they answer a technical need.

We believe that the situation which has developed in relation to the Upper Aquifer Investigation Technical Memorandum is an unfortunate one. Technical disagreements should be resolvable through discussions between the parties rather than under the threat of orders and enforcement. This is especially true in light of the Executive Committee's clear commitment to expediting the remedial work at the ACS Site. In order to avoid the recurrence of this situation, we request that a procedure to resolve real technical disputes be established for this project. The establishment of such a procedure would be one of the topics of discussion for the meeting between the group and the agencies' managements.

Turning to your specific comments, as noted, we disagree with many of the statements made. With this letter, we are resubmitting a Technical Memorandum which responds to your comments by deleting certain information which we continue to believe to be technically accurate and adding

certain wells and piezometers that we believe are unnecessary. Our positions are reflected in our comment responses. Our purpose in providing the revised Technical Memorandum is to allow this project to proceed without further delay. However, our revisions should not be construed as reflecting agreement with all of EPA's asserted positions. Once you have had an opportunity to review these responses and the revised Technical Memorandum, we believe that the meeting between the Group and U.S. EPA/IDEM would be the appropriate forum for continuing the discussion on these items.

We suggest that the meeting with the agencies be scheduled as soon as possible. We are available to meet on May 16th or May 21st at 1:00. Please call and let us know which of those dates is preferable as soon as possible.

Responses to Comments

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Review Comments

Upper Aquifer Investigation Technical Memorandum, March 15, 1996
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Superfund Site, Griffith, Indiana

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In response to U.S. EPA's requirements, Montgomery Watson developed detailed SOPs for collecting the upper aquifer samples and for operation and QA/QC of the field gas chromatograph (GC). The SOPs were followed fully, and resulted in useful data. The GC field screening was used appropriately. The conclusions developed in the Technical Memorandum are not based solely on these results. The field screening played a supplemental role in developing the extent of contamination.

The text in the Technical Memorandum already accomplishes the numbered items at the

end of the U.S. EPA comment. 1) The goals for the investigation in each area were clearly stated in the approved SOW and they were re-stated in the Technical Memorandum for each of the four Areas, A - D. 2) The limitations of the data are discussed in the Technical Memorandum. The discussion of uncertainty regarding the source of the low acetone concentrations (<50 ug/l) is a primary example. 3) Reasonable conclusions are presented in the Technical Memorandum for each of the investigation Areas, A through D. They are clearly labeled "Conclusions" with an underlined header. 4) Recommendations to place new upper aquifer monitoring wells were made on Page 10 and included the rationale for each location .

2. It is unclear if the structures portrayed on the maps have been surveyed in and are accurately depicted on the maps. This is important in visually understanding the character and extent of the contaminant plume.

Several structures (building outlines) are included on the basemap and therefore appear on Figures 1 - 6. The total number of structures shown on the maps have been kept to a minimum to reduce overall clutter. The coordinates for these in the original maps were derived from the topographic map based on the 1994 aerial photographs. One corner of each of these buildings was surveyed to confirm that they are accurately located on the basemaps. The coordinates of the four sides of the new pond constructed south of Reder Road have also been surveyed and will be included in future maps.

3. It is unclear whether the residential well discussion and represented locations refer to all or part of the private drinking water wells (e.g., residential wells) in the area of the site. The document needs to illustrate the location of all private wells near the site, indicate where the wells and discuss sampling those that may potentially be impacted by contamination migrating off-site. In addition, the report needs to state the intended analytical parameters for the proposed residential well samples. Lastly, as is mentioned further below, full scan analyses of these residential wells would be prudent for the first round of sampling. (See also specific comments below).

A residential well search is being conducted in the vicinity of the ACS Site. As agreed in the weekly conference call with the U.S. EPA, the findings will be included in the Lower Aquifer Technical Memorandum that will be submitted to the Agencies on May 3, 1996. The four residential wells proposed for sampling in the Upper Aquifer Technical Memorandum were specifically selected because they were located in the direct vicinity of the zone of benzene contamination delineated along Colfax Avenue. They were identified by a Montgomery Watson geologist, going door-to-door along Colfax Avenue and Reder Road, talking to each resident to ascertain the source of their water supply. The Technical Memorandum has been revised to state that full scan analyses will be performed for these initial four residential wells.

An alternative to providing the above-requested information regarding all the private well users in the revised upper aquifer technical memorandum is to include this information in the lower aquifer technical memorandum. However, Respondents must still sample the four (4) proposed wells for full scan to coincide with the collection of the groundwater samples from the new upper aquifer wells.

Full scan analysis is unnecessary and excessive for two reasons: 1) numerous sampling events have indicated that the contaminants of concern migrating off-site consist of the volatile organic compounds and 2), volatile organic compounds are more conservative than the semi-volatile compounds, PCBs, pesticides, and metals. However, at the direction of the U.S. EPA, the Technical Memorandum has been revised to provide such sampling for these specific wells. Being more conservative means that they are much more likely to travel with the groundwater. If no volatile organic compounds have migrated from the site to the sampled residential wells, it is technically valid to conclude that there is no completed pathway for the other, less conservative compounds, including the semi-volatile compounds, pesticides, PCBs, and metals.

4. The number and location of proposed additional upper aquifer monitoring wells; however, the presentation of data makes it difficult to appear inadequate adequately determine where additional wells are needed. First, the inferred plume is difficult to correlate with the existing ground water contours. Further, contour maps illustrating benzene, acetone, and total organic compound concentrations need to be provided to evaluate the distribution of these contaminants and the appropriate locations of additional monitoring wells. A map needs to be provided that illustrates all existing upper aquifer monitoring wells and piezometers, as well as proposed additional monitoring wells and groundwater elevation contours. When selecting the network, consider that the ultimate goal of this investigation the monitoring network will be used to verify the character, nature and extent of contamination today and over time. As is presented in the specific comment 26 below, U.S. EPA believes additional upper aquifer wells are necessary. In specific comment 26 below, U.S. EPA has shared its specific judgments of the deficiencies in the proposed monitoring network. U.S. EPA's opinions may change somewhat when the technical memorandum is supplemented with the information requested by U.S. EPA.

Most of what the U.S. EPA is requesting here was already included in the Upper Aquifer Technical Memorandum. The five figures in the first submittal of the Upper Aquifer Technical Memorandum contained the water table contours from the October 30, 1995 water level measurements. Figure 1 showed the existing upper aquifer wells and piezometers. Figure 5 showed the groundwater contamination plume as established by the upper aquifer field screening, and also showed the proposed monitoring well locations. All figures were purposefully provided at the same scale so that comparisons between any and all maps can be easily made.

It is not possible to develop a meaningful "contour map" of contaminant concentrations from the data developed for the Upper Aquifer Investigation. The sampling points were selected specifically to identify the outer extent of contaminant migration, and therefore, they are generally representative of the lowest concentrations at the site. Contour plots are useful when there is a range of contamination concentrations from high to low. The only meaningful "contour" line for the objectives of the upper aquifer investigation is the "zero" line which was presented on Figure 5.

A new figure has been added following Figure 4, and Figure 5 has been modified and renumbered as Figure 6 in the re-submitted Technical Memorandum. The new Figure 5 is a plot of total volatile organic concentration levels detected by field GC. Figure 6 (revised Figure 5) includes water table contour lines, the "zero" contaminant detection line, the existing monitoring wells and piezometers, and the locations of the new monitoring wells and piezometers proposed to complete the upper aquifer investigation.

5. The significance of the surface water sample needs discussion. Certainly the level of contamination found begs discussion and a proposal for additional work now that we know of the contamination. See also other specific comments below.

A zone of VOC contamination extends from the ACS site northward as shown on Figures 5 and 6. The zone ends in the vicinity of the drainage ditch that enters the site north of the ACS facility. The sample was collected near this ditch. It seems likely that the groundwater is discharging to the ditch. This is supported by the existence of benzene in the surface water sample, and the observation that the zone of benzene contamination in the upper aquifer does not extend significantly beyond the ditch. Further surface water sampling will be conducted in the wetland sampling planned for the summer. Assuming approval of the PGCS design by the U.S. EPA, the PGCS will be installed within the next year, and it will cut off the benzene contamination that is migrating off site to the north. Therefore, the source of the benzene and the seep will be cut off. All these actions are being conducted on an expedited schedule, so that remediation will occur far sooner than under the ROD remedy.

6. With regard to the issue of abandoning wells, U.S. EPA will defer comments until we see a proposal and data summary from the Respondents.

U.S. EPA requested, and so we have proposed timely abandonment of the six production wells at the ACS Site. We continue to believe that proper abandonment of these wells is appropriate.

7. Piezometer, P-57, as proposed in Respondents' technical memorandum dated November 8, 1995, should be installed.

The purpose of the piezometers is to provide water elevations at enough locations to provide an accurate indication of the water table configuration across and surrounding the

site, and aid in the evaluation of the groundwater flow pathways. At this time, there are over sixty piezometers at the site. The existing piezometers, along with the results of the field screening leave no ambiguity as to the water table configuration and the groundwater flow paths northeast of the ACS Site. Adding P-57 at this time would serve no technically significant purpose. Therefore, it is recommended that P-57 not be installed.

8. A staff gauge should be installed in the retention pond south of Colfax Avenue and Reder Road, as verbally proposed by Respondents.

A staff gauge will be installed prior to the next round of water levels collected at the site (assuming access can be gained). A surveyor will provide coordinates of the four sides of the pond, as well as reference elevation for the staff gauge, so that the pond and the staff gauge can be represented on the site map.

SPECIFIC COMMENTS

9. **Page 1.** The report states that the top-of-casing elevations for piezometer P-52 and monitoring well MW-18 were resurveyed during the Upper Aquifer investigation. The new survey values are presented, but the document does not discuss the difference between the old survey values or state the effect on the groundwater flow patterns. It is not clear if the elevations P-52 and MW-18 are different than previously determined. The text should note any changes and their significance, or at least note where this is discussed. If no significant difference are attributed to the resurveyed elevations this point should also be made.

The reference elevation for MW-18 was found to be correct. The reference elevation for P-52 was found to have been incorrectly reported in November 1995. The modification of the reference elevation for P-52 was made for the water table plots in Figures 1 - 5. The change resulted in a minor change in the orientation of the contour lines defining the "water table" in the wetland east of the ACS Site. However, the field screening results showed that the zone of contamination does not extend out into the wetland. Therefore, the resulting change in contour lines was not significant to the objectives or findings of the Technical Memorandum.

10. **Page 1, 2nd paragraph.** The boundaries of bulleted areas A,B,C and D described in this paragraph are not clear. Present the boundaries of these areas on Figure 1.

Areas A, B,C, and D were selected in the SOW to represent general areas that should be investigated with specific procedures. The areas are general and so the representation in Figure 1 is general. The letters A, B, C, and D are clearly marked and discussed in the text. No modifications to Figure 1 are necessary.

11. **Page 2, 3rd paragraph.** Present the location of MW-9 on Figure 1.

Figure 1 includes the upper aquifer monitoring wells and piezometers. Monitoring Well MW-9 is screened in the lower aquifer. Therefore it, along with the other lower aquifer wells, was not included on Figure 1.

12. **Page 2, 4th paragraph.** Provide the rationale for selecting the locations of the 8 "deep" groundwater samples described in this paragraph.

The U.S. EPA dictated the locations for the eight deep groundwater samples. The reason for collecting the samples was that the U.S. EPA requested that they be collected.

13. **Page 3, top of page.** On figures, provide the locations of the UST and industrial facilities discussed in item 2 at the top of the page.

In the Pre-Design Work Plan and the SOW, there was a focus on the UST and the industrial facilities as potential sources of contamination in the southeast area. The Upper Aquifer Investigation did not confirm that either of these potential sources are significant contributors to the groundwater contamination extending southeast from the Off-Site area. Therefore, detailed discussion of them is not warranted and has not been included in the Technical Memorandum. The brief reference on page 2 is simply to provide continuity with the SOW. Adding them to one of the Tech Memo figures would not serve any of the objectives of the Upper Aquifer Investigation.

14. **Page 5 & 6, Results and Conclusions.** The document states the suspected reasons for the presence of acetone at the site, including analytical difficulties, common laboratory contaminants and identification of acetone in vegetation, insects and bacteria as a naturally occurring metabolite. The analytical difficulties add to the complexity of interpreting the data. However, since the other hypotheses are not supported, these paragraphs should be deleted or at least substantially qualified. Discuss further the data quality, usage and limitations.

Clearly, acetone exists as a contaminant at the site. Figure 4 was developed to show the concentrations that were detected. The discussion on page 5 and 6 are specifically focused toward the low level detections (<50 ug/l) of acetone. It is important to keep focused on the objectives of the field screening that was conducted for this Technical Memorandum. The purpose of the field screening is to identify the locations to install additional upper aquifer monitoring wells. The results from sampling those wells will be used to resolve the acetone anomaly. The following discussion is valid, but it has been deleted from the Technical Memorandum at the direction of the U.S. EPA:

Acetone was added to the target analyte list after the field GC protocol had been established in the Specific Operating Procedures section of the Work Plan, because acetone was detected in a number of the water samples collected during the investigation. However, it is likely that concentrations of acetone below 50 ug/L in groundwater samples are attributable to instrument contamination. Acetone is not

well-suited for purge and trap GC analysis utilized for this investigation since it is a highly volatile and polar compound. Because the purge and trap methodology produces moisture within the system, acetone may be attenuated within the trap by the moisture and subsequently elute during multiple purge and trap analyses. In laboratory settings, acetone is a common contaminant which most analytical laboratories equipped with rigorous QA/QC procedures do not report at concentrations less than 20 ug/L.

Acetone has also been identified in vegetation, insects and bacteria as a naturally occurring volatile metabolite. Acetone is a breakdown product of alcohols and is produced through anaerobic degradation of organic matter. Near the ACS site, where wetland areas and farm fields are abundant, organic matter is available in soils at high concentrations (percent levels) for anaerobic degradation and may be contributing to the production of naturally occurring acetone.

Therefore, detections of low concentrations of acetone with a field GC (i.e., less than 50 ug/L) should be viewed as probable instrument cross-contamination or naturally occurring breakdown products, rather than viewed as representative of groundwater contamination.

There are multiple hypotheses that may be generated in explaining the widespread detection of acetone on-site, however, it is important to keep in mind the quality of the data generated by this type of investigation. Hence, the limitations of this data should be clearly stated since it will affect the conclusions. Furthermore, since acetone levels are very high in some locations, it is appropriate to discuss how these high levels may have effected detection limits of other parameters of interest. The most likely hypothesis that can be drawn from the data is that there is widespread "contamination" of acetone on site. Also, confirmatory samples which will be analyzed under strict QA/QC protocols and validation criteria will help define the contamination.

One potential factor of significance is that if these high levels of acetone do reflect lab "contamination", then the validity of all data, in general, is suspect due to the doubts cast on the quality assurance/quality control (QA/QC) of the collection and analysis of the samples. All data should then be further qualified.

Also, it seems inappropriate to attribute acetone concentrations to natural processes or lab contamination alone (especially with concentrations of 50 ug/l and greater). Further, there is no evidence to suggest that natural processes have contributed to acetone concentrations detected. Lab contamination is an inadequate explanation for detected concentrations of acetone which were less than 50 ug/l because high concentrations of acetone were found upgradient of these samples. At the 45 sampling locations where acetone was detected, 28 locations had validity of the aforementioned claims can be evaluated, supporting technical documentation must be provided. Confirmatory samples which will be analyzed under strict QA/QC protocols and validation criteria are necessary.

In addition, scientific documentation which discusses that acetone is naturally occurring in a wetland environment should be provided. When evaluating the concentrations (ranging from non-detect to 50.600 ppb) as provided in this document, it appears unlikely that the acetone is naturally occurring. Acetone is not easily formed due to the need to form a double bond. When alcohols break down, the final compound to be would be methane and water. Furthermore, acetone is very volatile and may well volatilize off during the exothermic reaction produced during the breakdown process of the alcohols and the resultant methane. Thus, a minimal amount would be present, if at all. Lastly, since acetone has the potential to migrate as rapidly and/or more rapidly as benzene, then it may help to explain why acetone is found at the leading edge of the groundwater plume.

15. **Page 6, paragraph 2.** As discussed above, the text states that low concentrations of acetone detected during the investigation "... should be viewed as probable instrument cross-contamination or naturally occurring breakdown products rather than viewed as representative of groundwater contamination." Based upon the frequency and magnitude of acetone detections this statement appears presumptuous. Furthermore, acetone was selected as a contaminant of concern in the ROD. Supplement this discussion to at least talk about acetone as a contaminant of concern at this site.

The purpose of this paragraph is to explain why the "low concentrations" of acetone are not being overly analyzed. It is not relevant to add text to this paragraph regarding the high acetone concentrations detected at other locations that clearly are site related.

The ROD lists the "Final Remediation Level" for acetone as 2,300 ug/l (to meet the HI =1). Therefore, it is valid to consider concentrations below 50 ug/l as of little significance.

16. **Page 6, Area A, Results.** As mentioned above, it is possible the high concentration of acetone may effect detection limits, such as at GP58. Hence, it is possible that the detection limits changed from GP57 to 58. Discuss further the data quality, usage and limitations.

The purpose of the introductory discussion of low acetone concentrations, was so that the specific discussion of "real" acetone could be carried out, as is done in the section referenced in this comment. U.S. EPA's request for further discussion is not relevant to this section of the report. However, in response to the U.S. EPA's comment, the discussion of the low acetone concentration has been removed from the text of the Technical Memorandum.

17. **Page 6, Conclusions, last paragraph, first sentence.** Add the word approximate before the word extent.

The word "approximate" has been added to the text.

18. Page 6, Conclusions, last paragraph, second sentence. Further explain the use of "zero" in the context of the line of "zero" contamination. It should be explained to state that the line of "zero" is the relative area where VOC contamination dropped to below reportable limits.

Quotation marks are used around the word zero for this express purpose. Text has been added to define this usage of "zero."

19. Page 7. Upward gradients in the wetland are hypothesized as controlling the VOC plume extent. While this is a reasonable hypothesis for the dissolved phase, it can be easily verified with a monitoring network installed later. Piezometers will verify gradients. If necessary, samples could also be obtained of both the groundwater and surface water. Periodic surface water sampling would seem important if this is true. Also, since PCB transport is still an issue, then surface water sampling is even more important. Discuss how these hypotheses will be verified.

Piezometers are not necessary to verify the hypotheses. It is a basic hydrogeologic principle that if groundwater is discharging to a wetland, or other surface water body, it does so because there is an upward hydraulic gradient. The water levels shown by the water table contour lines and the existence of the wetland is verification of the discharge. Since the total saturated thickness of the upper aquifer in this area is less than ten feet, there may be only a slight difference in head levels. Also, the zone in which the upward gradient will occur will move back and forth horizontally throughout the year as the water table rises and falls. Installation of additional piezometers is unnecessary. Furthermore, the PGCS will be operational within one year and the extraction trench component of the PGCS will contain sets of piezometers in this area.

PCBs have been found at low levels in the samples from the wetland. It is unclear whether the U.S. EPA is suggesting that the migration pathway for the PCBs is via groundwater. This seems unlikely since PCBs are hydrophobic and tend to partition to the aquifer matrix material rather than migrate with the groundwater.

20. Page 8, Conclusions, last paragraph, first sentence. Add the word approximate before the word extent.

The word "approximate" has been added to the text.

21. Page 8, Conclusions) paragraphs 2 - 4). Regarding the references to the UST and pipeline as potential sources of BTEX contamination, there is not sufficient data to support that the UST and pipeline are contributing to BTEX contamination. Provide additional information to support this inference or delete the inference.

The text does not say that the UST and the pipeline are THE source. It says they may be contributors to the plume. That is a reasonable assertion; IDEM has the report from the Town of Griffith, regarding the removal of the leaking UST at that location.

22. Page 8, last paragraph (Conclusions).

Delete the paragraph. There is no basis for stating that VOC concentrations in area C are "not significant". It is inappropriate to attribute acetone to natural processes or lab contamination. (See previous comments). A more appropriate conclusion would include further study of this area, including quarterly monitoring well sampling of M-1S and MW-15.

The paragraph has been modified to show the comparison between the "detected" concentrations of acetone and the "Final Remediation Level" for acetone of 2,300 ug/l listed in the ROD.

23. Page 9, Conclusions, second to last paragraph, first sentence. Add the word approximate before the word extent.

The word "approximate" has been added to the text.

24. Page 9, Conclusions, last paragraph, first sentence. Add the word approximate fore the word extent.

The word "approximate" has been added to the text.

25. Page 10, Area C bullet. This references a monitoring well "MW01". It appears that this reference is for the Griffith Landfill well M-1S. This needs to be corrected, to prevent confusion with the ACS MW-01 well that was destroyed in 1990.

The text has been modified in the revised Upper Aquifer Technical Memorandum.

26. Page 10. Based upon the information provided, following are U.S. EPA opinions and recommendations of the proposed monitoring network. Although final well locations will be verified by U.S. EPA and IDEM in the field, Respondents should provide a proposal which considers the following.

a) Area A:

Surface water sampling should be planned. Nested piezometers should be installed to verify gradients and allow for periodic chemical water quality samples to be obtained. Piezometers will be relatively easy to install and maintain. Locations should be on either side of the hypothesized chemical boundary and there should be a total of 6, two-piezometer nests installed. Given the historic conditions noted in MW 10 and vicinity, wells will likely be needed to show chemical changes through time and

should be anticipated.

Surface water sampling was planned in the Pre-Design work plan and will be conducted later this year. The existence of the wetland and the clearly defined edge of the plume is verification of the vertical gradients. Piezometers will be of limited value in defining vertical gradients in the upper aquifer because of the limited thickness (<10 feet) of the upper aquifer, and because the edge of the wetland is not stationary. Further, sets of piezometers will be installed in this area as part of the performance verification for the extraction trench for the PGCS.

However, as directed by the U.S. EPA in the April 29, 1996 clarification letter, the text of the Technical Memorandum has been modified to include piezometers in sets of two, at four locations. These are shown on Figure 6 as N-1, N-2, N3, and N-4.

An additional monitoring well is suggested approximately 100 feet southeast of the midpoint between MW-13 and M-5S. This distance between MW-13 and M-58 is over 1000 feet, and MW-14, the closest monitoring well between these wells, is contaminated. Hydropunch samples analyzed by a field GC can aid in the placement of monitoring wells; however they cannot reliably rule out the need for a monitoring well. Reliable long-term monitoring will require a well in the recommended location.

The wetland presents a hydraulic barrier that is similar to the effect of a lake. The water surface on a lake is flat, and therefore there is no horizontal gradient across the lake. This factor was understood during the RI and it is the reason that monitoring wells have not previously been placed in the wetland. The field screening investigation confirmed that there is no contaminant migration significantly beyond the "shore" of the wetland. The concentrations abruptly change from levels measured in the thousands, to non-detected, in a matter of a few feet. There is limited technical basis for installing any monitoring wells in the upper aquifer at this location.

However, at the insistence of U.S. EPA, a well is proposed for installation at this location. It is labeled "J" on Figure 6 of the revised Technical Memorandum.

b) Area B:

The inferred plume is difficult to correlate with the existing ground water contours. In addition, it is necessary to measure plume concentrations both within and on the edge of the inferred plume.

The plume is overlaid directly on the existing contours in Figure 6 (Figure 5 in the Technical Memorandum draft submitted in March 1996). While the contours do not extend beyond P-62, the plume that is defined by the "zero" line is clear and consistent with the extension of contour lines in the area.

Two wells are recommended (a cluster at each location) along the inferred plume axis, in addition to the well locations already shown. One monitoring well is suggested approximately 150 feet northeast of P-62, to provide adequate monitoring coverage of this area. An additional monitoring well is suggested approximately 500 feet south of P-62, to better define the nature of contamination within this area.

At the meeting with U.S. EPA and IDEM on April 23, 1996, the ACS Technical committee agreed to install an additional well interior to the plume extending southeast from the site. It is discussed on page 10 of the revised Technical Memorandum and it is labeled "T" on Figure 6

c) Area C:

No additional wells may be necessary for area C; however, wells MW-1S and MW15 should be added to quarterly monitoring to ensure adequate coverage of these areas. Delete or qualify the second sentence of this paragraph, which attributes acetone detection to field GC or natural processes.

At the detected concentrations, these do not represent significant contamination, in comparison to the "Final Remediation Level" for acetone, listed in the ROD (2,300 ug/l). This qualification is provided in the text of the revised Technical Memorandum. Given this fact, it may not be appropriate to include M-1S and MW-15 in the quarterly monitoring plan. However, at the U.S. EPA request, wells M-1S and MW15 will be considered for inclusion in the quarterly monitoring plan.

d) Area D:

The proposal for the wells designated E and F are insufficient. Given a linear expanse of more than 1,000 feet along the northern portion of the study area and the distance from the source areas the following is needed:

An additional upper aquifer monitoring well in the northern area of the plume was agreed to at the April 23, 1996 with U.S. EPA and IDEM. It is indicated by the symbol and letter "C" on Figure 6 of the revised Technical Memorandum.

i) Samples are needed at a minimum of 4 locations on the northern boundary of Area D are recommended. At least two locations will consist of a shallow and deep pair of wells in the upper aquifer. Drilling shall be to and confirm the clay layer. If the upper sand is less than 15 feet thick in this area, single wells with a 10 foot well-screen should be allowable in lieu of the two well cluster.

At the insistence of U.S. EPA, two additional wells have been added to the upper aquifer investigation inside the contaminant plume zone north of the ACS facility. These are indicated by the symbols and letters "L" and "M" on Figure 6 in the revised Upper Aquifer Technical Memorandum.

The ACS Technical Committee does not feel that either of these monitoring well locations is appropriate at this time. Location "M" is interior to the area of contamination and does not provide any additional information needed to proceed with the remediation. Nor is it certain at this time that it will be a useful monitoring point after the PGCS has been installed and is operational. Location "L" is within the planned alignment for the groundwater extraction trench for the PGCS. If it is placed at this location, it will be damaged during the construction of the extraction trench. It may be that a compliance monitoring well will be useful in this vicinity at some time in the future, but that decision would be better made after the PGCS has been installed and is operational.

ii) Several shallow well clusters are anticipated along Colfax Avenue. A monitoring well is suggested between P-58 and P-59 just outside the line where benzene was detected, as specified on figure 5. This well will provide coverage of the area between MW-11 and MW-12, which are over 1000 feet apart. A monitoring well is suggested near P-63 to better define the nature of contamination in this area.

During the discussion with U.S. EPA and IDEM on April 23, 1996, the ACS Technical Committee agreed to place an additional upper aquifer monitoring well at the location discussed above. It is indicated by the symbol and letter "D" on Figure 6 in the revised Upper Aquifer Technical Memorandum.

27. Page 11, paragraph 2, Residential Well Identification and Sampling.

It is unclear whether the residential well discussion and represented locations refer to all or part of the area residential wells. The document needs to illustrate the location of all private wells near the site, and discuss sampling those that may potentially be impacted by contamination migrating off-site. Provide a map or database of all known drinking water wells in the area. Also, include a discussion of the local businesses in the area, including if the businesses have a private well which is used as a potable drinking water source. Include on a figure the location of the municipal water supply lines and provide a brief discussion of the municipal water supply. This will avoid any confusion as to the elimination of certain residences/businesses from sampling consideration in the vicinity of the site.

See response to General Comment 3.

As previously discussed, there may be additional drinking water wells (primarily residences) which will need to be included in this sampling round.

The residential wells proposed for sampling are screened in the lower aquifer, and are located south of the site. Any wells in

the area that are in the upper aquifer should be proposed for sampling. Given that the gradient of the lower aquifer is northerly, residential and industrial wells downgradient (north) of the site should also be identified and sampled.

Finally, residential well samples should be analyzed for the full scan of analytical parameters to assure that no contamination escapes detection to be the most protective of human health. Provide rationales for the residences which are proposed to be sampled.

See response to General Comment 3.

28. Page 11, last paragraph. This states that "One surface water sample was collected near P-61 north of the ACS facility (Figure 2)." The report previously states that the sample collected near piezometer P-63, and Figure 2 does not illustrate the location of the surface water sample. This needs to be corrected.

The text of has been corrected in the revised Technical Memorandum.

Furthermore, no conclusion is provided on how the Respondents intend to proceed based on this new information. Clarify this approach.

Clarification has been added to the text in the revised Technical Memorandum.

29. Page 11, Surface Water Samples. The surface water sample location was not plotted on the map. The surface water sample appears to have been collected near P-63, rather than P-61. Include the sampling location and ditch on figure 2.

Given the levels found, more surface water sampling will be necessary. The hypothesized upward gradients in the wetland also point to the need for additional surface water sampling. Discuss how this will be approached and provide a proposal. Results, conclusions, and recommendations for the surface water sample location should be included in the text.

The need for surface water sampling has been anticipated and is included in the Pre-Design Work Plan as the Wetland Investigation. This additional sampling, which has already been discussed and agreed to with U.S. EPA and IDEM, will be conducted during the summer, following approval of the QAPP.

30. Table 1. Include all wells on Figure 1. For instance, MW 10C is not shown and should be included.

The subject of this Technical Memorandum is the upper aquifer. Monitoring Well MW-10C is not an upper aquifer monitoring well, therefore, it is not included on Figure 1.

31. **Table 1, Summary of Sample Coordinates and Depths.** The text indicates that GP-54 was not sampled. Also, incorporate the east/north coordinates.

This modification was made in Table 1 of the revised Technical Memorandum.

32. **Table 2, Tabulation of Selected VOC Detections Upper Aquifer Investigation.** The column of total VOCs appears to be misleading. It appears that the total column is a total of acetone, benzene and BTEX columns. Clarification of which VOCs comprise this total VOCs column is needed.

The table has been modified in the revised Technical Memorandum.

33. **Appendix A.** Place a title on the table. In addition, several items need clarification, including, (a) provide explanations for certain concentrations being placed in italics; (b) as previously discussed, the total VOCs column appears confusing and needs additional clarification; (c) on page 2 of 15, GP-60 indicates an acetone concentration of 3560 with an asterisk. Provide a footnote to explain the meaning of the asterisk, and (d) the nomenclature utilized for trip and field blanks is inconsistent throughout the table (i.e., GPTB01 1/24/96, GP-1/26/96/TB, TB 2/1/96). Correct these inconsistencies.

Modification has been made in the revised Technical Memorandum.

34. **Appendix B.** This information or data was not timely submitted to IDEM. In the future, provide the information to both U.S. EPA and IDEM along with the document which it is supposed to be included in.

Appendix B was supplied to U.S. EPA because it was specifically requested. When IDEM requested it, it was also immediately supplied to IDEM.

35. **Appendix B.** While reviewing the time-series data for IW-1 contained in Appendix B, U.S. EPA noted that tetrachloroethene (PCE) concentrations dropped from approximately 10 to 12 ug/l near the start of the pumping and leveled off at about 5 ug/l after 180 minutes. In reporting this data, it is not accurate to state that the time series data indicated that PCE concentrations at the well began high and then over time dropped to zero. Rather it appears that PCE concentrations from 180 to the end of the test (i.e., 480 minutes) leveled off at a concentration of approximately 5 UG/L. This may be important in the lower aquifer technical memorandum as well as the well abandonment proposal.

Time-series sampling was conducted as part of the Lower Aquifer Investigation and was therefore included in the Lower Aquifer Technical Memorandum, submitted to U.S. EPA on May 3, 1996.

As noted above, if questions remain after the U.S. EPA and IDEM have reviewed these responses, we are interested in meeting with you and your management to resolve any remaining issues. We look forward to hearing from you once your review is completed.

Very Truly Yours,

MONTGOMERY WATSON INC.



Peter J. Vagt, Ph.D., CPG
Vice President

cc: Holly Grejda, IDEM (5)
Steve Mrkvika, B&BWS, (2)
ACS Technical Committee

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TECHNICAL MEMORANDUM

UPPER AQUIFER INVESTIGATION

ACS NPL SITE PRE-DESIGN

(REVISED: MAY 3, 1996)

This Technical Memorandum presents the results, conclusions, and recommendations from the Upper Aquifer Investigation conducted at the ACS NPL site in Griffith, Indiana between February 5 and March 4, 1996. The purpose of the Upper Aquifer Investigation was to delineate the extent of groundwater contamination in the upper aquifer and to propose additional upper aquifer monitoring well locations at the site, if necessary. Groundwater samples were collected from 110 temporary sampling points with a hydraulic probe and analyzed for target VOCs using a field gas chromatograph (GC). The target VOC list included the most frequently detected VOCs in Site groundwater (benzene, ethylbenzene, toluene, xylene, chlorobenzene, 1,2-dichloroethene, and 1,1-dichloroethane). The results of the analyses were utilized to locate additional sampling points and delineate the extent of VOC contamination in the upper aquifer.

The Upper Aquifer Investigation was conducted in accordance with the Scope of Work and Specific Operating Procedures (SOPs) approved by U.S. EPA and IDEM. Investigation activities were divided and focused on four areas of the site labeled A, B, C, and D on Figure 1. These areas correspond to the following:

- A - Wetland Area West of the ACS Facility
- B - East of Colfax, South of Reder Road
- C - Southwest of the Griffith Landfill
- D - North and East Perimeter

Sampling locations utilized for the Upper Aquifer Investigation are shown on Figure 2. In this Technical Memorandum, objectives and sampling locations are initially presented according to area, followed by a summary of the sampling procedures utilized for the investigation. Results and conclusions for each area are subsequently presented followed by recommendations for completing the upper aquifer investigation and placement of additional upper aquifer monitoring wells at the site.

Although not included in the Scope of Work for the Upper Aquifer Investigation, three additional tasks were completed during the investigation and reported in this document. In response to U.S. EPA concerns regarding groundwater elevation data in the upper aquifer, top-of-casing elevations were resurveyed at piezometer P-52 and monitoring well MW-18 to verify the groundwater elevations measured in these wells. The resurveyed top-of-casing elevations for these two wells are 636.66 feet (NGVD) and 644.89 feet, respectively. The revised survey information for these two wells was utilized to plot the upper aquifer groundwater elevation presented in Figures 1 through 6. The groundwater elevation used for this plot was measured at the site on October 30, 1995. The resurveyed elevations for

these two wells resulted in a minor change in the orientation of the contour lines defining the water table in the wetland area east of the ACS Site. The revised water table contour lines changed from a more north-south orientation to generally east-west, indicating that the direction of groundwater flow is more southerly than easterly in the wetland area.

The second task added during the course of the investigation was the identification of private wells located east of Colfax Avenue, and south of Reder Road. This information is included along with recommendations to sample four private wells on page 11.

The third task involved collection and field analysis of a surface water sample collected near piezometer P63. The analytical results of the surface water sample are presented at the conclusion of the document.

SAMPLING OBJECTIVES AND LOCATIONS

Area A - Wetland Area West of the ACS Facility

Direction of groundwater flow in the upper aquifer in Area A is generally to the west and southwest from the ACS facility. Because monitoring wells have not been placed to the west (downgradient) of wells MW-13 and MW-9 located at the edge of the wetland area, the extent of contaminated groundwater had not been defined in the area. The objectives of the Area A investigation were to:

1. Establish the line to the west of Area A which defines the extent of contamination as indicated by "zero" VOC concentrations (non-detect) in groundwater.
2. Determine whether VOC contamination extends below the upper five feet in the upper aquifer at selected locations along the plume front.

To accomplish these objectives, 22 shallow and eight deep upper aquifer groundwater samples were collected and analyzed for target VOCs. Sampling locations GP50 through GP71 and GP115 on Figure 2 show the locations of the shallow (five feet below the watertable) groundwater sampling locations. Deep groundwater samples were collected at a depth of approximately 10 feet below the watertable at locations GP50, GP51, GP52, GP57, GP66, GP68, GP70 and GP71 (Figure 2). The locations of the deep groundwater samples were selected by the U.S. EPA. Sampling points were generally oriented in lines perpendicular to the north and south railroad right-of-ways at a spacing of approximately 100 feet between samples (based on field accessibility).

Area B - East of Colfax, South of Reder Road

The hydraulic gradient in Area B is generally to the south, with some southwestern orientation in the vicinity of a groundwater high near MW-18. VOC concentrations previously detected in wells MW-6 and MW-19 indicated that upper aquifer contamination may extend from MW-6 to beyond MW-19. (Monitoring well locations are plotted on Figure 1.) Prior to starting the investigation, several industrial facilities along the south side of Reder Road and a former UST located in the City of Griffith yard were identified as

potentially contributing to the VOC contamination detected in MW-6 and MW-19. The objectives of sampling Area B included:

1. Delineate the extent of VOC concentrations east and south of MW-19.
2. Evaluate the potential for the UST and several industrial facilities located in the area to be contributing to the VOC plume detected at MW-19.

To meet these objectives, 45 groundwater samples were collected and analyzed for target VOCs. Sampling locations GP80 through GP89, GP116 through GP124, GP126 through GP136, GP143 through GP147, and GP150 to GP161 correspond to the sampling locations utilized for the Area B investigation (Figure 2). Sampling was generally conducted in areas near the former UST and the intersection of Reder Road and Colfax Avenue, in an area east of piezometer P61, and in grid-like manner south of a line between monitoring well MW-19 and piezometer P62. Except for samples collected near the former UST, the spacing of samples was approximately 200 feet wherever practicable.

Area C - Southwest of the Griffith Landfill

Because trace levels of VOCs were detected in MW-15, there was a question whether VOCs may be present in the groundwater outside the landfill zone between monitoring wells M-1S and MW-15. The hydraulic gradient in Area C is generally to the southwest (Figure 1). The objective of the Area C investigation was to determine if VOCs are migrating southwest of the landfill between monitoring wells M-1S and MW-15.

Seven groundwater samples were collected along the abandoned railroad right-of-way between Colfax Avenue and M-1S. Two additional groundwater samples were collected on private property located southwest of the railroad right-of-way. The sampling locations are designated as samples GP73 through GP79, GP148, and GP149 on Figure 2.

Area D - North and East Perimeter

Previous data collected in 1990 from the north and east side of the ACS site suggested that the outer extent of groundwater contamination was defined by a line extending from MW-18 to the south, approximately 200 feet east of MW-12, and to the northeast by MW-11. Based on water level measurements collected in the area, the upper aquifer groundwater generally flows to the north from MW-18, northwest in the vicinity of MW-11 and flows westerly towards MW-13 (Figure 1). The extent of VOC concentrations around the north and east perimeter is apparently limited by the groundwater flow system in the area. The objective of the Area D investigation was to:

1. Confirm the extent of VOC concentrations in the upper aquifer around the north and east perimeter of the site.
2. Delineate the outer extent of contaminated groundwater in the upper aquifer.

Thirteen groundwater samples were collected in the area east of Colfax Avenue (samples GP90 through GP99 and GP101 through GP103) and 20 samples were collected north of

the railroad tracks, north of the ACS site (samples GP100, GP104 through GP114, GP125, and GP137 through GP144). The locations of the samples are shown on Figure 2. In general, samples were collected in a linear fashion east of Colfax Avenue at a spacing of approximately 200 feet. In the north perimeter area, samples were also collected at an approximate 200 foot spacing as allowed by field accessibility.

PROCEDURES

Field Sampling

Upper aquifer groundwater sampling from the hydraulic probes was conducted in accordance with the SOP for the Upper Aquifer Investigation (revision: January 19, 1996) with the following exceptions:

- The number of shallow groundwater samples collected during the Upper Aquifer Investigation in all of the areas was expanded to include additional sample locations. The total number of sampling locations increased from the 50 locations estimated in the Work Plan to 110 locations utilized for this investigation.
- The number of samples collected from a depth of ten feet below the watertable in the upper aquifer in Area A increased from the two specified in the Work Plan to eight locations, including six requested by the U.S. U.S. EPA during the investigation (GP52A, GP57A, GP66A, GP68A, GP70A, and GP71A).
- The originally planned "deep" samples were collected at GP50A and GP51A. Because clay was found to be located at less than a ten foot depth, these samples were collected at a depth of 9 and 7 feet below the water table respectively.
- Sample GP115 was added at U.S. U.S. EPA request, between GP70 and the landfill.
- No samples were collected from locations GP131 and GP147 because water could not be drawn through the fine sand clogged geoprobe screen.
- Purge volumes were reduced for some low-yielding sample locations, including GP112, GP121, GP122, GP131, GP132, GP153, GP157, GP160, and GP161.
- The sample from GP54 was not analyzed because the odor and color indicated that it was contaminated. A groundwater sample was subsequently collected approximately 100 feet west of this location to delineate the extent of contamination (GP53).
- Two samples were collected from a depth of four feet rather than five feet below the watertable due to inadvertent placement of the slotted screen at GP91 and GP119.

- Water could not be collected from the five foot depth at location GP145, so the probe was driven and additional two feet in depth and the sample was collected from a depth of seven feet.
- A sample could not be collected at location GP72 because of cold weather conditions. A sample was subsequently collected in the same area, and identified as GP80.
- Two sampling locations, GP87 and GP90, yielded foamy samples, so zero-headspace samples could not be collected. The samples were brought to the field GC for immediate analysis from these locations.
- As a result of fine sand clogging the well point used in accordance with the SOP, water samples obtained from GP151 through GP161 were collected by advancing a finely slotted screen (0.010 inch slotted rod 36 inches long by 0.76-inch diameter) enclosed inside the lead probe to the desired sampling depth (5 feet below the watertable). The probe casing was retracted from around the screen, exposing the screen in the aquifer. Water samples were then collected from the probe in accordance with the approved SOP.

Field GC Analysis

The approved SOP for the Upper Aquifer Investigation required that upper aquifer samples be analyzed for the compounds: benzene, ethylbenzene, toluene, xylene, chlorobenzene, 1,2-dichloroethene (1,2-DCE), and 1,1-dichloroethane (1,1-DCA). The following were also included in the analysis for the upper aquifer investigation:

- 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE), tetrachloroethene (PCE), acetone, methyl isobutyl ketone (MIBK), methyl ethyl ketone, carbon tetrachloride, and styrene.

These compounds were added to the analyte list since the GC was already calibrated to analyze for these analytes for the Lower Aquifer Investigation.

RESULTS AND CONCLUSIONS

Table 1 presents the location coordinates and sampling depths of the upper aquifer groundwater samples. Field analytical results for benzene, acetone, BETX and total VOCs are presented in Table 2. Because benzene and acetone were most frequently detected in shallow groundwater at the site, concentrations of benzene and acetone are also plotted on Figures 3 and 4, respectively. Figure 5 shows the plot of total VOC concentrations detected at the sampling points (total VOCs corresponds to the sum total of target VOCs detected with the field GC). Field GC analytical reports for the target compounds in all samples are tabulated in Appendix A. Data quality associated with the Upper Aquifer Investigation was in accordance with the approved SOW and SOP. A discussion of the analytical results and

conclusions associated with the Upper Aquifer Investigation is presented according to applicable area of the Site (i.e., A, B, C, or D).

Area A - Wetland Area West of the ACS Facility

Results

VOCs, primarily benzene and acetone, were detected in the wetland area west of the ACS facility. Figures 3 and 4 show the concentrations of benzene and acetone detected in the area, respectively. Acetone was the most prevalent VOC detected in Area A found in 11 samples (Figure 4). The highest level of acetone was found in GP58 where acetone was detected at an estimated concentration of 50,600 ug/L. However, at a distance of approximately 100 feet west and southwest of this location, acetone was not detected above quantitation limits. South of GP58 and GP60, acetone was detected at significantly lower concentrations (Figure 4).

Benzene was only detected in three samples in the wetland, GP53, GP55, and GP57, at concentrations of 550 ug/L, 5000 ug/L and 400 ug/L, respectively. Other VOCs detected in groundwater samples collected from GP53 and GP55 include cis- and trans-1,2-DCE and toluene (Appendix A).

A comparison of the eight deeper groundwater samples collected adjacent to shallow samples is shown in Table 3. At GP57, both benzene and acetone were detected at higher concentrations in the 10 foot deep sample compared to five foot deep sample. At the other nested sample locations, acetone was the only VOC detected in samples (GP50, GP68) and was found at slightly higher concentrations in the deep samples. No VOCs were detected in either the shallow or the deeper samples collected at GP51, GP52, GP66, GP70 and GP71.

Conclusions

The approximate extent of contamination in the upper aquifer has been defined in the wetland area west of the ACS facility. A line of "zero" VOC concentrations ("zero" is defined as concentrations of VOCs below detection limits) was established in the upper aquifer by samples (from north to south) GP62, GP61, GP66, GP52, GP71, GP51 and GP70. This is consistent with Objective #1 established for the Area A investigation.

The line of "zero" contamination forms a sharp boundary which coincides with the border between the wetland area to the west and dry land to the east. In the area near GP57, benzene concentrations sharply decreased from 5000 ug/L at GP57 to less than detection limits at GP58 located approximately 100 feet west. Other areas exhibit a similar abrupt decrease in contaminant concentration over a relatively small distance. This sharp boundary is unlike other areas of the site which typically exhibit groundwater contamination as a gradational zone. The sharp contrast between contaminated and non-contaminated groundwater in Area A is likely due to the wetland area acting as a discharge boundary for the upper aquifer groundwater flow system. Where there is standing water, there will be essentially no horizontal gradient and therefore, no driving force to push the benzene contaminated water further out into the wetland.

The results of the deep groundwater samples in the upper aquifer indicate that VOC sampling five feet below the water table provide results that are representative of the entire saturated thickness of the upper aquifer. This is evidenced by the lack of VOC detections in shallow and deep groundwater samples GP51/GP51A, GP52/GP52A, GP66/GP66A, GP70/GP70A and GP71/GP71A which are located downgradient of samples containing higher concentrations of VOCs. This data shows that objective #2 for Area A has been met.

Area B - East of Colfax, South of Reder Road

Results

VOCs were detected in many of the groundwater samples collected in Area B (Table 2). Figures 3 and 4 show the concentrations of benzene and acetone, respectively, detected in the area. The highest VOC concentrations were found in groundwater samples collected just north of the UST located at the City of Griffith landfill and south of the intersection of Colfax and Reder Roads. Benzene was detected as high as 6,950 ug/L near the former UST (GP124), and was also found at elevated concentrations south of Reder Road (4,580 ug/L in GP121, and 3,430 ug/L in GP82). Acetone was detected near the UST, ranging in concentration from 3,900 ug/L in GP87 to 6,000 ug/L in GP123, and south of Reder Road at concentrations ranging from 834 ug/L in GP122 to 4,780 ug/L in GP121 (Figure 4). Other VOCs detected in the area include 1,2-dichloroethane, 1,1,1-TCA, toluene, ethylbenzene, xylenes and styrene (Appendix A).

South of the intersection of Colfax and Reder Roads, the highest concentrations of VOCs, primarily benzene, acetone, ethylbenzene and xylene, were detected at GP116, GP120, GP128 and GP134. These sampling locations are generally located in a north-south line approximately 600 to 700 feet east of Colfax Road (see Figure 2). East and west of this line, VOCs were either generally not detected or found at concentrations significantly less than the central line. VOCs were not found in GP84, GP85, GP86, and GP132 to the east of this line, whereas to the west, VOCs were not detected in GP118, GP129, GP135 and GP145 (Table 2).

Benzene concentrations in the central plume decreased from GP82 (3,430 ug/L) to the north to GP120 (131 ug/L), then increased again to the south from GP120 (131 ug/L) to GP128 (506 ug/L) to GP134 (1100 ug/L). South of GP134, benzene concentrations decreased again at GP143, GP144 and GP156 (Figure 3). The southern and southeastern extent of benzene contamination in the upper aquifer was delineated by groundwater samples collected at GP151 to GP155 and GP158 and GP159. Benzene was not detected at sample locations GP135 and GP145 located further to the west.

Acetone concentrations generally decreased with distance to the south from the site (Figure 4). The southernmost detection of acetone occurred at GP156, located approximately 1600 feet southeast of the intersection of Colfax and Reder roads, where acetone was detected at 34 ug/L. Acetone was not detected in GP118, GP129 GP144, and GP155 to the west, GP159 and GP158 to the southeast, and GP85, GP132, GP151, and GP152 and to the east.

Two isolated detections of acetone occurred at GP153 and GP157 where acetone was found at 15 ug/L and 38 ug/L, respectively.

Conclusions

There are several potential sources of elevated BETX concentrations upgradient of monitoring well MW6, near the intersection of Colfax and Reder Roads. Possible sources include the UST area at the City of Griffith garage, the Off-Site Containment area and the area designated as the Kapica-Pazmey area in the RI. It appears that there is a zone of VOC contamination in the upper aquifer extending from the Kapica-Pazmey area, south from monitoring well MW-6 to MW-19 and beyond.

The approximate extent of VOC contamination in the upper aquifer south of Reder Road was defined during the investigation. A line of "zero" VOC detections can be established in the upper aquifer by samples which surround the plume of benzene and acetone to the west, south and east. This is consistent with Objective #1 established for the Area B investigation. With respect to Objective #2, the UST area in the Griffith town yard cannot be ruled out as an additional source of benzene.

Area C - Southwest of Griffith Landfill

Results

Acetone was the only VOC detected in Area C at three sampling locations. The acetone concentrations range from 34 ug/L in GP73 to 57 ug/L in GP74. Concentrations of acetone detected in GP73 and GP74 were not detected in groundwater samples collected 200 feet southwest (Figure 4).

Conclusions

Acetone was the only VOC sporadically detected in this area at concentrations less than 57 ug/L. Acetone was selected as a contaminant of concern for the ACS Site in the Record of Decision (ROD). However, when comparing the concentration of acetone detected at GP74 (57 ug/L) to the "Final Remediation Level" for acetone in the ROD (2,300 ug/L), the detected concentrations of acetone in Area C are well below these levels.

Area D - North and East Perimeter

Results

East of Colfax Road, VOCs were detected in groundwater samples collected from GP90, GP91, GP92, GP93 and GP94. The highest VOC concentrations were found in GP90, located near the intersection of Colfax and Reder Roads, where cis-1,2-DCE, total BETX, and MIBK were detected at 25,700 ug/L, 52,720 ug/L and 8,960 ug/L, respectively (Appendix A). At GP91, located 200 feet north of GP90, total VOC concentrations decreased to 16.2 ug/L, and at GP101, located approximately 400 feet east, VOCs were not detected.

VOCs were detected above quantitation limits in only one of the upper aquifer groundwater samples collected east of the north-south line of points defined by GP90 to GP93. The VOC, 1,2-DCA, was detected at a concentration of 10 ug/L in GP94 (Appendix A).

North of the ACS site in Area D, VOCs were detected in samples GP104 through GP108, GP112, GP114, GP139 and GP140 (Table 2). The highest VOC concentrations were detected in samples GP105 and GP107, where total VOCs were 327 ug/L and 6,213 ug/L, respectively (Table 2). These samples contained several VOC constituents, including acetone, benzene, 1,1-DCA, cis-1,2-DCE, and MIBK above the quantitation limit. The distribution of benzene and acetone in the north perimeter area is presented in Figures 3 and 4, respectively. Benzene was detected only in GP105, GP106 and GP107, whereas acetone was detected in samples collected throughout the area (Figure 4). In samples GP139 and GP140, acetone was the only compound detected in the groundwater samples.

Conclusions

The approximate extent of impacted groundwater has been defined along the east perimeter of the ACS site by the Upper Aquifer Investigation. The absence of VOC detections in samples GP95 through GP101 indicates that VOCs have not migrated beyond 300 feet east of Colfax Road. This is consistent with both the results of previous investigations and the upper aquifer groundwater flow system in the area (Objective #1). Groundwater flow in a northerly direction on the east perimeter of the ACS site appears to provide a hydraulic barrier to eastward migration of VOCs (Figure 1).

The approximate extent of benzene contamination north of the ACS site is defined by groundwater samples from locations GP108, GP139 to GP140, GP113 and GP104 (Figure 3). With exceptions of the detection of acetone in several samples and MIBK detected in GP108, the extent of the benzene plume also corresponds to the outer limits of VOC contamination (Objective #2). The extent of acetone detections was not defined to a "zero" line north of samples GP139 and GP140 in the perimeter area. The low level detections of acetone appear to decrease to the north onto LaSalle Steel property. (Monitoring wells planned for this area will provide further data for the final clarification of the acetone anomaly.)

RECOMMENDATIONS

Based on the results and conclusions of the Upper Aquifer Investigation, the overall objective of the investigation, to delineate the extent of upper aquifer contamination sufficiently to locate the placement of additional monitoring wells, has been satisfied around the site.

The following actions are proposed to complete the delineation of upper aquifer VOC contamination.

Area A - The approximate extent of VOC contamination has been defined by a series of closely spaced (100 foot) sampling locations. The sampling showed a clear

delineation between the zones of contamination and non-contamination. VOC contamination does not extend westward, beyond the edge of the wetland. Because of the clear delineation of VOC contamination, and the difficulties inherent in constructing monitoring wells within the wetlands, no additional monitoring wells are warranted in this area. However, in a letter dated April 29, 1996, U.S.EPA is requiring that one monitoring be installed in Area A at the location labeled as J on Figure 6. A copy of the U.S. EPA letter is attached as Appendix D.

Also, as required in the April 29, 1996 letter, U.S.EPA is requiring that seven to eight piezometers be installed at four locations as piezometer nests in Area A. Each piezometer nest would consist of two piezometers each. One piezometer would be installed at the base of the upper aquifer and a second would be installed at the water table surface. If appropriate, existing piezometer P-23 may be used as one piezometer as one location. The piezometer nest locations, N-1, N-2, N-3 and N-4, are shown on Figure 6.

Area B - Four monitoring wells are proposed to supplement existing well MW-19 in defining the limits of VOC contamination in this area. The preliminary locations of the four wells, labeled E, F, G, and H, are shown on Figure 6. The wells will be installed in close proximity to the location where shallow groundwater samples were collected at GP135, GP159, GP151 and GP155. These locations have been selected to surround the VOC plume and provide an indication of whether the extent of contamination is remaining constant or expanding. Final locations will be selected in the field, based on accessibility, with concurrence from the U.S. EPA, its field oversight subcontractor and IDEM.

Monitoring well, I, will be located in the central portion of the plume to monitor the nature of contamination within the plume. This well will be located near GP134 where elevated concentrations of benzene were detected.

In a letter dated April 29, 1996, U.S. EPA is requiring one additional monitoring well in Area B (Appendix D). This monitoring well is labeled as K on Figure 6.

The actual locations of all Area B wells will be selected in the field, based on accessibility, with concurrence from the U.S. EPA, its field oversight subcontractor and IDEM.

Area C - No monitoring wells are proposed for the southwest side of the landfill. Acetone was the only VOC sporadically detected in this area at concentrations less than 57 ug/L. This concentration is significantly less than the "Final Remediation Level" listed in the ROD for acetone which is 2,300 ug/L. Two existing monitoring wells located in Area C (M-1S, MW15; Figure 1) will

continue to serve as sentinel wells for monitoring potential contaminant migration southwest of the landfill area should such monitoring become appropriate.

Area D - Four additional monitoring wells screened in the upper aquifer are proposed along the north and east sides of the site. The locations, labeled A, B, C, and D on Figure 6, have been selected at the boundaries of the VOC plume in this area. The proposed wells will act as sentinel wells, providing an indication whether the extent of contamination is remaining constant or expanding.

In a letter dated April 29, 1996, U.S. EPA is requiring two additional monitoring wells in Area D (Appendix D). The locations of these wells, labeled as L and M, are shown on Figure 6.

Final locations of Area D monitoring wells will be selected in the field, based on accessibility, with concurrence from the U.S. EPA, its field oversight subcontractor and IDEM.

UPPER AQUIFER INVESTIGATION SOPs

Additional predesign investigation of the upper aquifer will include installation, development and sampling of upper aquifer monitoring wells, and sampling of residential wells (see below). SOPs developed for performing these tasks are included in Appendix C. The analytical parameters for the proposed upper aquifer sampling are summarized in Table 4.

RESIDENTIAL WELL IDENTIFICATION AND SAMPLING

Due to the dimensions of the VOC plume east of Colfax and south of Reder Road, locations of residential wells in this area were identified which may be potentially susceptible to VOC migration along the well casing from the upper aquifer to the lower aquifer (lower aquifer is the formation in which the residential wells are screened). Four residential wells have been identified in the area and are listed below:

- 1002 Reder Road
- 430 East Avenue H
- 940 Arbogast
- 938 Arbogast

The locations of the properties are shown on Figure 6. It is recommended that water samples be collected from these four residential to coincide with the collection of groundwater samples from the new monitoring wells proposed in this Technical

Memorandum. Water samples from these four wells will be analyzed for full scan TCL/TAL list. An analytical summary is presented in Table 4. A full scan will be performed on these four well although if the analytical results do not show detections of semi-volatiles, metals or other non-volatile constituents, any future residential well sampling should require VOC analysis only.

The locations of other private wells located in the vicinity of the upper aquifer VOC plume southeast of the ACS Site are presented in the May 1996 Lower Aquifer Investigation report. Surrounding well locations are plotted on Figure 8 of the Lower Aquifer Technical Memorandum and a summary of updated private well information is presented in Table 11 of the Lower Aquifer Technical Memorandum.

A schedule for installing and sampling the new upper aquifer monitoring and for sampling the residential wells will be prepared and submitted to the Agencies ten days after this Upper Aquifer Investigation report is approved.

SURFACE WATER SAMPLE

One surface water sample was collected near P63, north of the ACS facility. The location of the surface water sample is shown on Figure 5. The sample was taken from standing surface water adjacent to a ditch that flows beneath the railroad tracks from properties north of the site (i.e., LaSalle Steel) towards the wetland area (Area A). The water sample was analyzed with the field GC and found to contain benzene at 1100 ug/L. No other VOCs were detected in the water sample.

Surface water sampling at the ACS Site was originally included in the Pre-Design Work Plan as the Wetland Investigation. Collection and field GC analysis of a surface water sample during the Upper Aquifer Investigation served to provide notice that a Wetland Investigation, as described in the Pre-Design Work Plan and discussed with James Chapman of the U.S. EPA, is indeed needed at the site to determine the nature and extent of surface water impacts. Additional sampling in the wetland area will be conducted during the summer, following U.S. EPA final approval of the Wetland Investigation SOW and SOP.

Attachments:

- Table 1. Summary of Sampling Coordinates and Depths
- Table 2. Tabulation of Selected VOC Detections
- Table 3. Comparison of Shallow and Deep Groundwater Samples in the Upper Aquifer
- Table 4. Summary of Monitoring Well Analytical Parameters

- Figure 1. Upper Aquifer Sampling Areas
- Figure 2. Upper Aquifer Sampling Points
- Figure 3. Upper Aquifer Plot of Benzene Detections (ug/L)
- Figure 4. Upper Aquifer Plot of Acetone Detections (ug/L)
- Figure 5. Total VOC Concentrations in Upper Aquifer (ug/L)
- Figure 6. Location of Proposed Monitoring Wells and Residential Well Sampling

- Appendix A. Tabulation of VOC Analyses with Field GC
- Appendix B. Field GC Printouts and Plots (available upon request)
- Appendix C. Upper Aquifer Investigation SOPs
- Appendix D. April 29, 1996 letter from U.S. EPA

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Table 1. Summary of Sample Coordinates and Depths
ACS NPL Site

Probe No.	East feet	North feet	Approx. G.W. Level feet	Approx. Sample Depth feet
GP50	4756.5	7309.0	3.0	8.0
GP-50A	4756.5	7309.0	3.0	12.0
GP51	4568.2	7240.7	1.5	6.5
GP-51A	4568.2	7240.7	1.5	8.5
GP52	4813.6	7857.5	0.5	5.5
GP52A	4687.4	7519.2	0.5	10.5
GP53	5042.0	7618.2	1.5	6.5
GP55	5026.8	7451.6	1.0	6.0
GP56	4994.1	7750.3	1.0	6.0
GP57	4938.8	7658.5	1.5	6.5
GP57A	4938.8	7658.5	1.5	11.5
GP58	4829.8	7705.0	1.0	6.0
GP59	4751.7	7615.9	1.0	6.0
GP60	4830.7	7537.2	1.5	6.5
GP61	4741.4	7752.7	1.0	6.0
GP62	4687.4	7519.2	1.5	6.5
GP63	4855.1	7259.5	1.5	6.5
GP64	4798.0	7166.3	1.0	6.0
GP65	4763.6	7087.3	1.0	6.0
GP66	4716.0	7632.5	1.0	6.0
GP66A	4716.0	7632.5	1.0	11.0
GP67	4723.3	7432.8	1.0	6.0
GP68	4731.6	7032.7	2.5	7.5
GP68A	4731.6	7032.7	2.5	12.5
GP69	4747.1	7168.2	2.0	7.0
GP70	4616.5	7064.6	1.5	6.5
GP70A	4616.5	7064.6	0.0	10.0
GP71	4628.8	7420.4	0.5	5.5
GP71A	4628.8	7420.4	0.0	10.0
GP72	5472.9	5563.3	ns	ns
GP73	4797.3	4726.1	5.0	11.0
GP74	4698.9	4904.4	4.5	11.0
GP75	4606.8	5082.5	5.5	11.0

Table 1. Summary of Sample Coordinates and Depths
ACS NPL Site

Probe No.	East feet	North feet	Approx. G.W. Level feet	Approx. Sample Depth feet
GP76	4509.4	5257.8	5.0	10.0
GP77	4395.7	5420.9	4.5	10.5
GP78	4305.3	5619.1	5.0	10.0
GP79	4212.7	5795.8	5.0	10.0
GP80	5472.9	5563.3	19.0	24.0
GP81	5622.8	5547.8	15.0	20.0
GP82	5621.1	5352.5	9.0	14.0
GP83	5822.3	5356.9	9.0	14.0
GP84	5797.9	5171.7	9.0	14.0
GP85	5806.4	4972.5	5.0	10.0
GP86	5976.4	5043.0	6.0	11.0
GP87	5111.6	5523.4	10.0	15.0
GP88	5160.6	5368.9	13.0	18.0
GP89	5118.5	5565.8	21.0	26.0
GP90	5538.8	5705.9	19.0	24.0
GP91	5610.7	5891.5	17.0	21.0
GP92	5725.9	6086.7	13.0	18.0
GP93	5802.3	6267.1	11.0	16.0
GP94	6149.4	6280.2	10.0	15.0
GP95	6230.7	6472.2	4.0	9.0
GP96	6298.7	6648.4	4.0	9.0
GP97	6295.1	6832.1	4.0	9.0
GP98	6350.2	7046.3	4.0	9.0
GP99	6410.4	7280.7	6.0	11.0
GP100	6405.0	7678.9	6.0	11.0
GP101	5944.6	5706.5	10.0	15.0
GP102	5994.6	5905.4	10.0	15.0
GP103	6062.3	6086.4	3.0	8.0
GP104	6217.2	7736.6	3.0	8.0
GP105	6002.5	7753.3	4.0	9.0
GP106	5818.0	7827.9	3.0	8.0
GP107	5581.7	7906.7	2.0	7.0
GP108	5398.0	7984.1	2.0	7.0
GP109	5195.9	7973.0	3.0	8.0

Table 1. Summary of Sample Coordinates and Depths
ACS NPL Site

Probe No.	East feet	North feet	Approx. G.W. Level feet	Approx. Sample Depth feet
GP110	4949.6	8072.4	4.0	9.0
GP111	6368.8	7845.2	5.0	10.0
GP112	6138.2	7961.0	3.0	8.0
GP113	5985.9	7954.8	4.0	9.0
GP114	5794.2	8025.5	4.0	9.0
GP115	4592.5	6905.3	6.0	11.0
GP116	5651.9	4835.4	5.0	10.0
GP117	5435.5	4793.5	2.0	7.0
GP118	5084.4	4798.9	4.0	9.0
GP119	5777.1	4741.2	5.0	9.0
GP120	5594.5	4625.2	1.5	6.5
GP121	5393.1	5512.7	21.0	26.0
GP122	5305.8	5361.2	15.0	20.0
GP123	5114.8	5612.9	21.0	26.0
GP124	5231.1	5606.3	22.0	27.0
GP125	6234.4	7399.7	10.0	15.0
GP126	5889.3	4782.9	3.0	8.0
GP127	5816.6	4591.6	4.0	9.0
GP128	5587.7	4518.1	3.0	8.0
GP129	5392.9	4629.7	3.0	8.0
GP130	5275.9	4790.1	4.0	9.0
GP131	6088.4	4830.5	ns	ns
GP132	6056.7	4630.5	4.0	9.0
GP133	5929.2	4450.4	5.0	10.0
GP134	5737.9	4367.5	4.0	9.0
GP135	5489.0	4348.2	7.0	12.0
GP136	5398.1	4501.4	3.0	8.0
GP137	6252.8	8061.6	4.5	9.5
GP138	6039.3	8131.7	3.0	8.0
GP139	5877.2	8195.5	4.0	9.0
GP140	5650.8	8208.5	5.0	10.0
GP141	5458.5	8139.6	4.0	9.0
GP142	5229.5	8092.5	6.0	11.0
GP143	5923.7	4120.5	5.0	10.0

Table 1. Summary of Sample Coordinates and Depths
ACS NPL Site

Probe No.	East feet	North feet	Approx. G.W. Level feet	Approx. Sample Depth feet
GP144	5735.3	4126.4	4.0	9.0
GP145	5545.9	4217.0	5.0	12.0
GP146	5728.0	3713.4	4.0	9.0
GP147	5737.9	3303.0	ns	ns
GP148	4571.6	4681.2	9.0	14.0
GP149	4495.9	4858.4	6.0	11.0
GP150	4971.8	4804.2	4.0	9.0
GP151	6125.5	4434.9	4.0	9.0
GP152	6186.9	4209.7	4.0	9.0
GP153	5616.1	4023.2	1.0	6.0
GP154	5696.9	3863.9	2.0	7.0
GP155	5907.7	3879.7	2.5	7.5
GP156	6077.8	4003.6	2.0	7.0
GP157	5511.0	3980.2	1.0	6.0
GP158	6296.3	3994.5	3.0	8.0
GP159	6147.1	3809.8	2.0	7.0
GP160	5511.0	3877.1	1.0	6.0
GP161	5413.9	4054.1	0.5	5.5

notes:

1. ns - no sample collected
2. No sample collected from GP72. Sample obtained from same location later and renamed GP80.
3. Sample collected from GP54 was not analyzed due to high concentrations. Location of GP54 was not surveyed.

Table 2. Tabulation of Selected VOC Detections (revised)
Upper Aquifer Investigation, ACS NPL Site

Probe Number	Coordinates		Acetone (ug/L)	Benzene (ug/L)	BETX (ug/L)	Total VOCs (ug/L)
	Easting	Northing				
GP50	4756.5	7309.0	19	nd	nd	19
GP51	4568.2	7240.7	nd	nd	nd	nd
GP52	4813.6	7857.5	nd	nd	nd	nd
GP53	5042.0	7618.2	210	550	573	813
GP55	5026.8	7451.6	15	400	400	420
GP56	4994.1	7750.3	6,700	nd	nd	6,700
GP57	4938.8	7658.5	770	5,000	5,000	5,770
GP58	4829.8	7705.0	50,600	nd	nd	50,600
GP59	4751.7	7615.9	11	nd	nd	11
GP60	4830.7	7537.2	3,560	nd	nd	3,560
GP61	4741.4	7752.7	nd	nd	nd	nd
GP62	4687.4	7519.2	nd	nd	nd	nd
GP63	4855.1	7259.5	nd	nd	nd	nd
GP64	4798.0	7166.3	12	nd	nd	12
GP65	4763.6	7087.3	nd	nd	nd	nd
GP66	4716.0	7632.5	nd	nd	nd	nd
GP67	4723.3	7432.8	715	nd	nd	715
GP68	4731.6	7032.7	17	nd	nd	17
GP69	4747.1	7168.2	nd	nd	nd	nd
GP70	4616.5	7064.6	nd	nd	nd	nd
GP71	4628.8	7420.4	nd	nd	nd	nd
GP72	5474.1	5558.7	ns	ns	ns	ns
GP73	4797.3	4726.1	34	nd	nd	34
GP74	4698.9	4904.4	57	nd	nd	57
GP75	4606.8	5082.5	nd	nd	nd	nd
GP76	4509.4	5257.8	nd	nd	nd	nd
GP77	4395.7	5420.9	nd	nd	nd	nd
GP78	4305.3	5619.1	31	nd	nd	31
GP79	4212.7	5795.8	nd	nd	nd	nd
GP80	5472.9	5563.3	nd	7,860	22,803	23,120
GP81	5622.8	5547.8	1,720	nd	13,868	18,803
GP82	5621.1	5352.5	4,450	3,430	21,550	29,460
GP83	5822.3	5356.9	nd	nd	17	17
GP84	5797.9	5171.7	nd	nd	nd	nd
GP85	5806.4	4972.5	nd	nd	nd	nd
GP86	5976.4	5043.0	nd	nd	nd	nd
GP87	5111.6	5523.4	3,900	410	660	4,560
GP88	5160.6	5368.9	159	nd	nd	159
GP89	5118.5	5565.8	2,910	1,060	6,560	9,470
GP90	5538.8	5705.9	3,960	8,260	52,720	93,010
GP91	5610.7	5891.5	nd	nd	6	16

Table 2. Tabulation of Selected VOC Detections (revised)
Upper Aquifer Investigation, ACS NPL Site

Probe Number	Coordinates		Acetone (ug/L)	Benzene (ug/L)	BETX (ug/L)	Total VOCs (ug/L)
	Easting	Northing				
GP92	5725.9	6086.7	82	nd	nd	82
GP93	5802.3	6267.1	43	5	5	53
GP94	6149.4	6280.2	nd	nd	nd	10
GP95	6230.7	6472.2	nd	nd	nd	nd
GP96	6298.7	6648.4	nd	nd	nd	nd
GP97	6295.1	6832.1	nd	nd	nd	nd
GP98	6350.2	7046.3	nd	nd	nd	nd
GP99	6410.4	7280.7	nd	nd	nd	nd
GP100	6405.0	7678.9	nd	nd	nd	nd
GP101	5944.6	5706.5	nd	nd	nd	nd
GP102	5994.6	5905.4	nd	nd	nd	nd
GP103	6062.3	6086.4	nd	nd	nd	nd
GP104	6217.2	7736.6	48	nd	nd	48
GP105	6002.5	7753.3	205	53	53	327
GP106	5818.0	7827.9	38	118	118	156
GP107	5581.7	7906.7	860	5,320	5,320	6,213
GP108	5398.0	7984.1	nd	nd	nd	6
GP109	5195.9	7973.0	nd	nd	nd	nd
GP110	4949.6	8072.4	nd	nd	nd	nd
GP111	6368.8	7845.2	nd	nd	nd	nd
GP112	6138.2	7961.0	172	nd	nd	172
GP113	5985.9	7954.8	nd	nd	nd	nd
GP114	5794.2	8025.5	53	nd	nd	53
GP115	4592.5	6905.3	nd	nd	nd	nd
GP116	5651.9	4835.4	240	710	5,926	6,216
GP117	5435.5	4793.5	175	nd	nd	175
GP118	5084.4	4798.9	nd	nd	nd	nd
GP119	5777.1	4741.2	17	5	5	32
GP120	5594.5	4625.2	719	131	376	1,095
GP121	5393.1	5512.7	4,780	4,580	11,840	16,620
GP122	5305.8	5361.2	834	nd	nd	834
GP123	5114.8	5612.9	6,000	1,590	3,680	18,600
GP124	5231.1	5606.3	3,810	6,950	6,950	10,760
GP125	6234.4	7399.7	nd	nd	nd	nd
GP126	5889.3	4782.9	51	nd	nd	67
GP127	5816.6	4591.6	13	nd	nd	19
GP128	5587.7	4518.1	nd	506	5,376	5,376
GP129	5392.9	4629.7	nd	nd	nd	nd
GP130	5275.9	4790.1	168	nd	nd	168
GP131	6088.4	4830.5	ns	ns	ns	ns
GP132	6056.7	4630.5	nd	nd	nd	nd
GP133	5929.2	4450.4	62	5	5	67

Table 2. Tabulation of Selected VOC Detections (revised)
Upper Aquifer Investigation, ACS NPL Site

Probe Number	Coordinates		Acetone (ug/L)	Benzene (ug/L)	BETX (ug/L)	Total VOCs (ug/L)
	Easting	Northing				
GP134	5737.9	4367.5	412	1,100	1,133	1,630
GP135	5489.0	4348.2	nd	nd	nd	nd
GP136	5398.1	4501.4	19	5	5	25
GP137	6252.8	8061.6	nd	nd	nd	nd
GP138	6039.3	8131.7	nd	nd	nd	nd
GP139	5877.2	8195.5	50	nd	nd	50
GP140	5650.8	8208.5	21	nd	nd	21
GP141	5458.5	8139.6	nd	nd	nd	nd
GP142	5229.5	8092.5	nd	nd	nd	nd
GP143	5923.7	4120.5	59	252	357	416
GP144	5735.3	4126.4	nd	172	172	172
GP145	5545.9	4217.0	nd	nd	nd	nd
GP146	5728.0	3713.4	nd	nd	nd	nd
GP147	5737.9	3303.0	ns	ns	ns	ns
GP148	4571.6	4681.2	nd	nd	nd	nd
GP149	4495.9	4858.4	nd	nd	nd	nd
GP150	4971.8	4804.2	nd	nd	nd	nd
GP151	6125.5	4434.9	nd	nd	nd	nd
GP152	6186.9	4209.7	nd	nd	nd	nd
GP153	5616.1	4023.2	15	nd	nd	15
GP154	5696.9	3863.9	nd	nd	nd	nd
GP155	5907.7	3879.7	nd	nd	nd	nd
GP156	6077.8	4003.6	34	39	39	73
GP157	5511.0	3980.2	38	nd	nd	38
GP158	6296.3	3994.5	nd	nd	nd	nd
GP159	6147.1	3809.8	nd	nd	nd	nd
GP160	5511.0	3877.1	nd	nd	nd	nd
GP161	5413.9	4054.1	nd	nd	nd	nd

notes:

1. nd - not detected
2. ns - no sample collected
3. total VOCs - sum total of target VOCs (Appendix A)

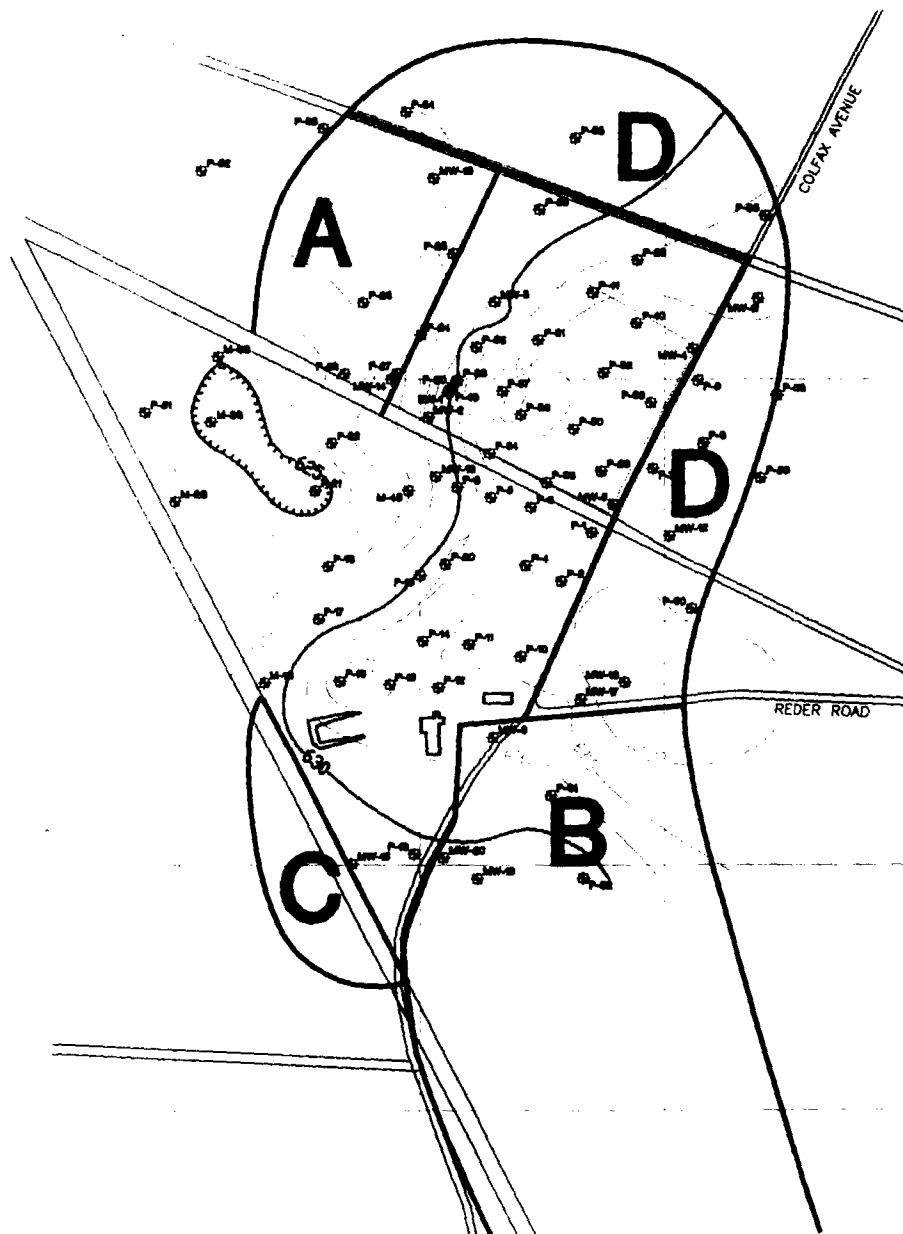
Table 3. Comparison of Shallow and Deep Groundwater Samples in Upper Aquifer
ACS NPL Site

<u>Probe No.</u>	<u>Approx. Sample Depth (ft)</u>	<u>Concentration (ug/L)</u>	
		<u>Benzene</u>	<u>Acetone</u>
GP-50	8.0	nd	19
GP-50A	12.0	nd	44
GP-51	6.5	nd	nd
GP-51A	8.5	nd	nd
GP-52	5.5	nd	nd
GP-52A	10.5	nd	nd
GP-57	6.5	5,000	770
GP-57A	11.5	44,700	1,400
GP-66	6.0	nd	nd
GP-66A	11.0	nd	nd
GP-68	7.5	nd	17
GP-68A	12.5	nd	348
GP-70	6.5	nd	nd
GP-70A	10.0	nd	nd
GP-71	5.5	nd	nd
GP-71A	10.0	nd	nd

Note: "A" designation indicates deep groundwater sample (i.e., 10 foot depth).

Table 4
Summary of Monitoring Well Analytical Parameters
American Chemical Service, Inc.
Griffith, Indiana

Well Number	TCL VOCs	Low Level TCL VOCs	TCL Semi- Volatile/PCBs	TAL Metals	
<u>Monitoring Wells</u>				<u>total</u>	<u>dissolved</u>
A	x		x	x	x
B	x		x	x	x
C	x		x	x	x
D	x		x	x	x
E	x		x	x	x
F	x		x	x	x
G	x		x	x	x
H	x		x	x	x
I	x		x	x	x
J	x		x	x	x
K	x		x	x	x
L	x		x	x	x
M	x		x	x	x
<u>Residential Wells</u>					
1002 Reder Road		x	x	x	x
430 East Avenue A		x	x	x	x
938 Arbogast		x	x	x	x
940 Arbogast		x	x	x	x



LEGEND

- A** LOCATION OF INVESTIGATION AREAS - SEE TEXT FOR FURTHER DESCRIPTION
- UPPER AQUIFER WELL LOCATION AND NUMBER
- LEACHATE/UPPER AQUIFER WELL LOCATION AND NUMBER
- PIEZOMETER LOCATION AND NUMBER
- GROUNDWATER ELEVATION CONTOUR

NOTES

1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

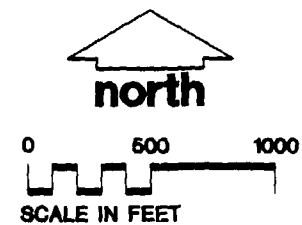
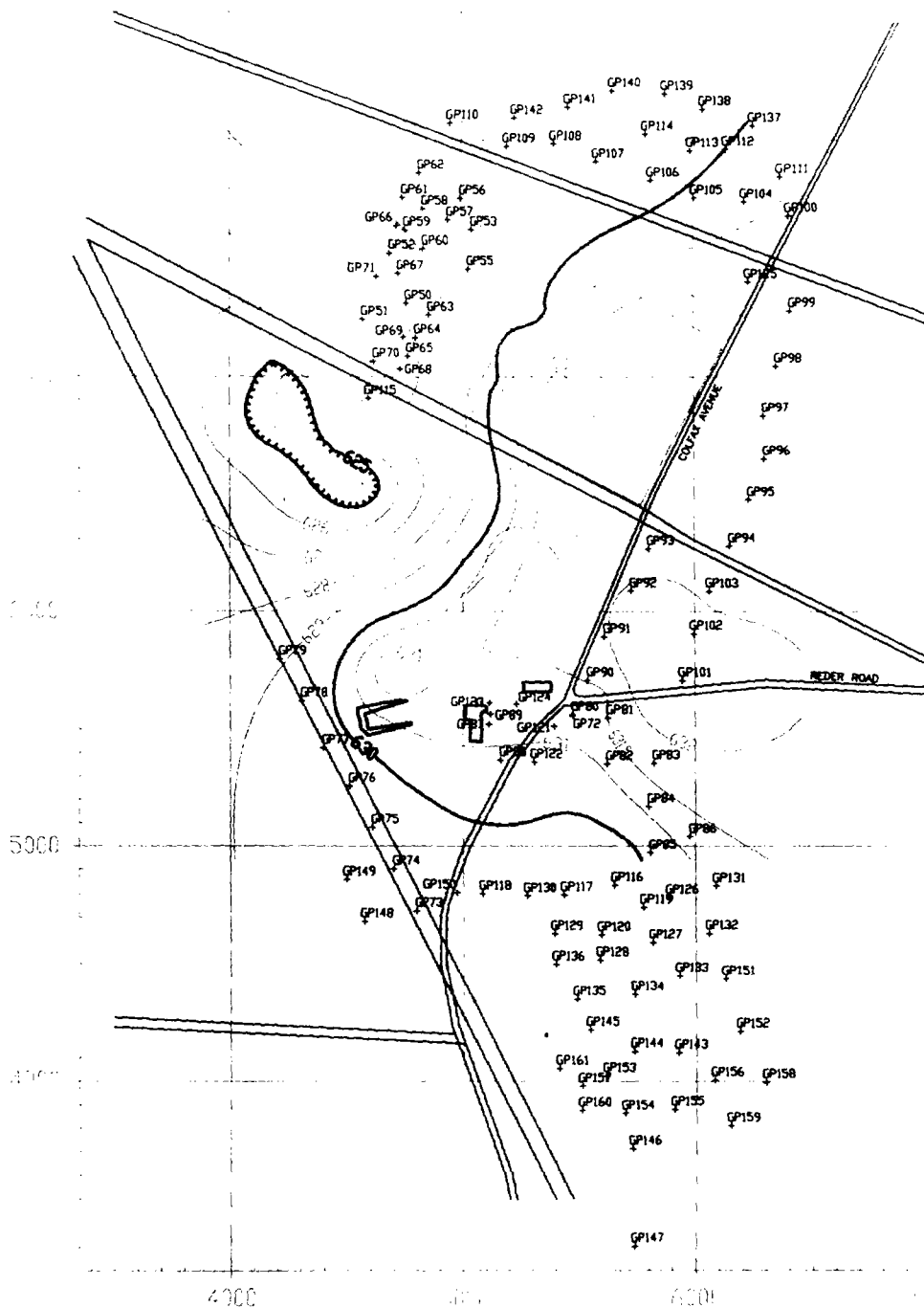


FIGURE 1



LEGEND

GP148 GROUNDWATER SAMPLING POINT LOCATION AND NUMBER, WITH TOTAL VOLATILE ORGANIC COMPOUNDS (ug/L)

NOTES

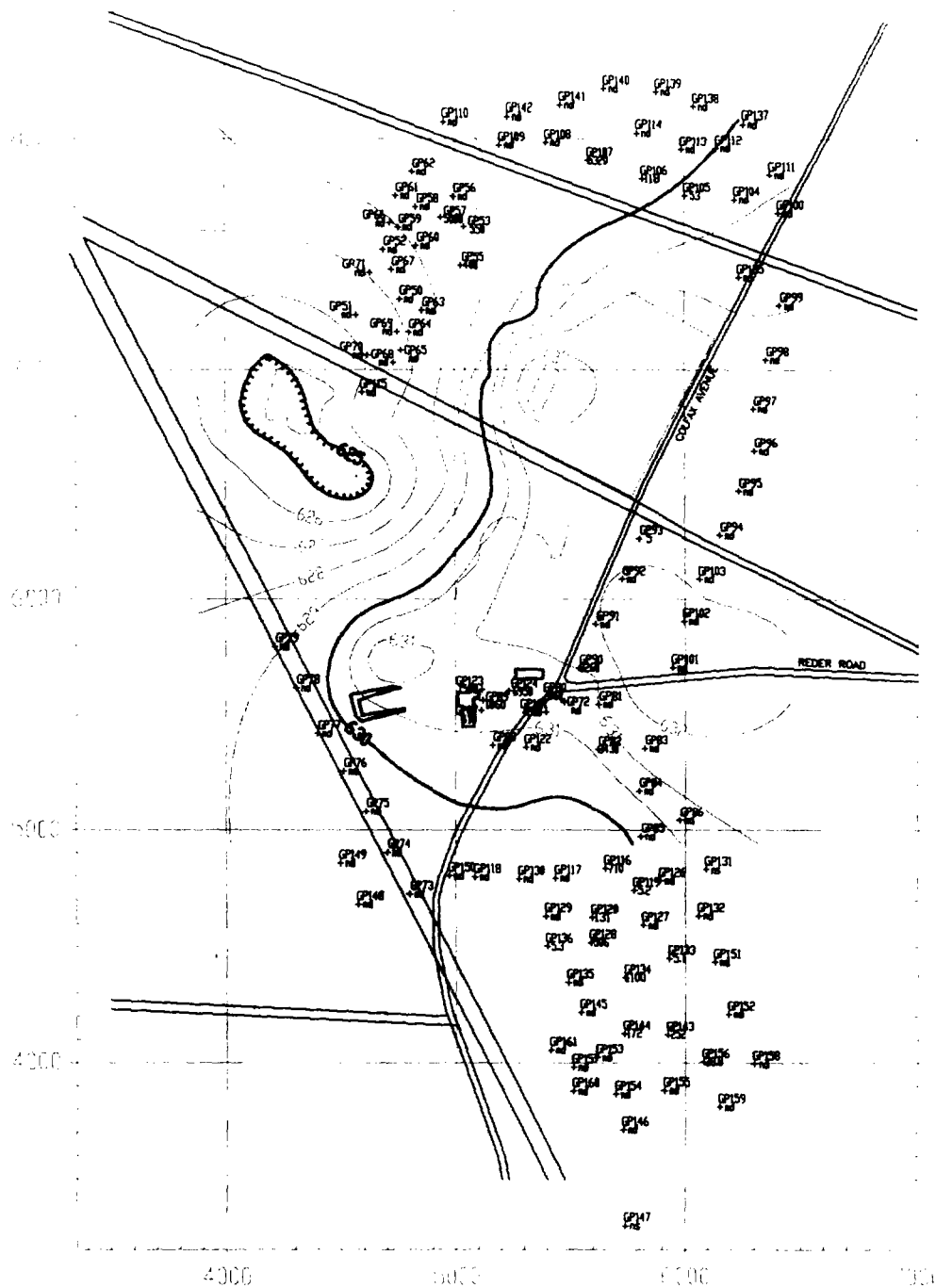
1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.



0 500 1000
SCALE IN FEET

FIGURE 2

	Drawing Number 4077.0072 B5	UPPER AQUIFER SAMPLING POINTS UPPER AQUIFER INVESTIGATION AMERICAL CHEMICAL SERVICE, INC. NPL SITE GRIFFITH, INDIANA	Developed By PV Approved By PV Reference Revisions	Drawn By CCM Date 5/24/96
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LEGEND

- GP48 GROUNDWATER SAMPLING POINT LOCATION AND NUMBER, WITH TOTAL VOLATILE ORGANIC COMPOUNDS (ug/L)
- nd NOT DETECTED
- ns NOT SAMPLED

NOTES

1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

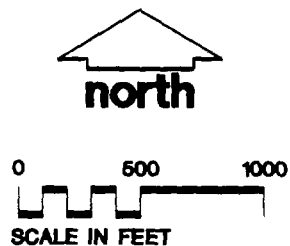
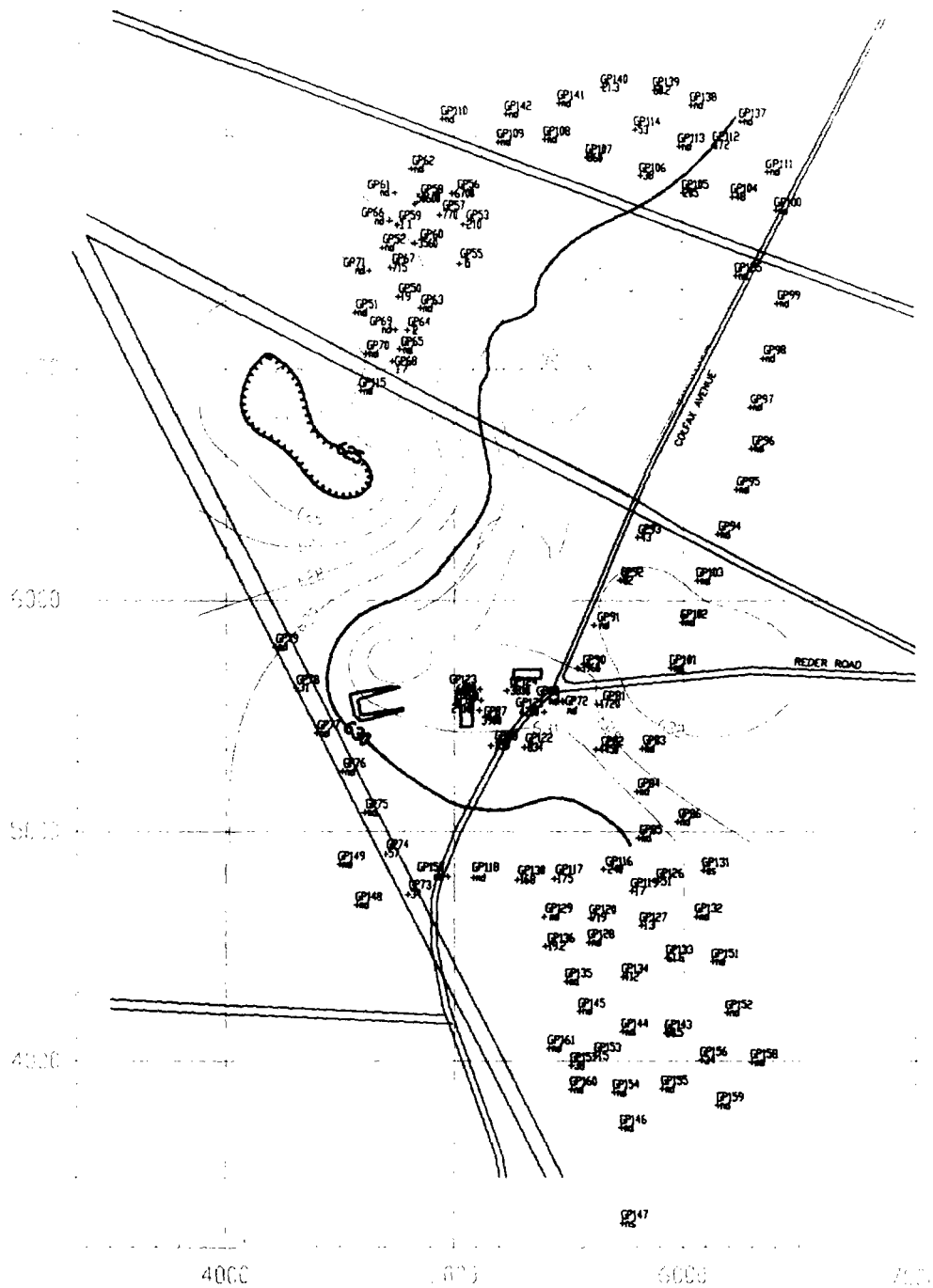


FIGURE 3

Montgomery Watson
Drawing Number
4077.0072 B4

UPPER AQUIFER PLOT OF
BENZENE DETECTIONS (ug/L)
UPPER AQUIFER INVESTIGATION
AMERICAL CHEMICAL SERVICE, INC.
NPL SITE
GRIFFITH, INDIANA

Developed By PV Drawn By CCM
Approved By [Signature] Date 5/4/96
Reference
Revisions



LEGEND

- GP48 GROUNDWATER SAMPLING POINT LOCATION AND NUMBER, WITH TOTAL VOLATILE ORGANIC COMPOUNDS (ug/L)
- nd NOT DETECTED
- ns NOT SAMPLED

NOTES

1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

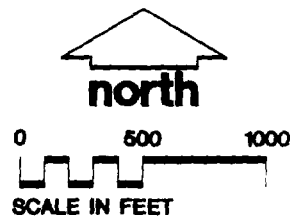
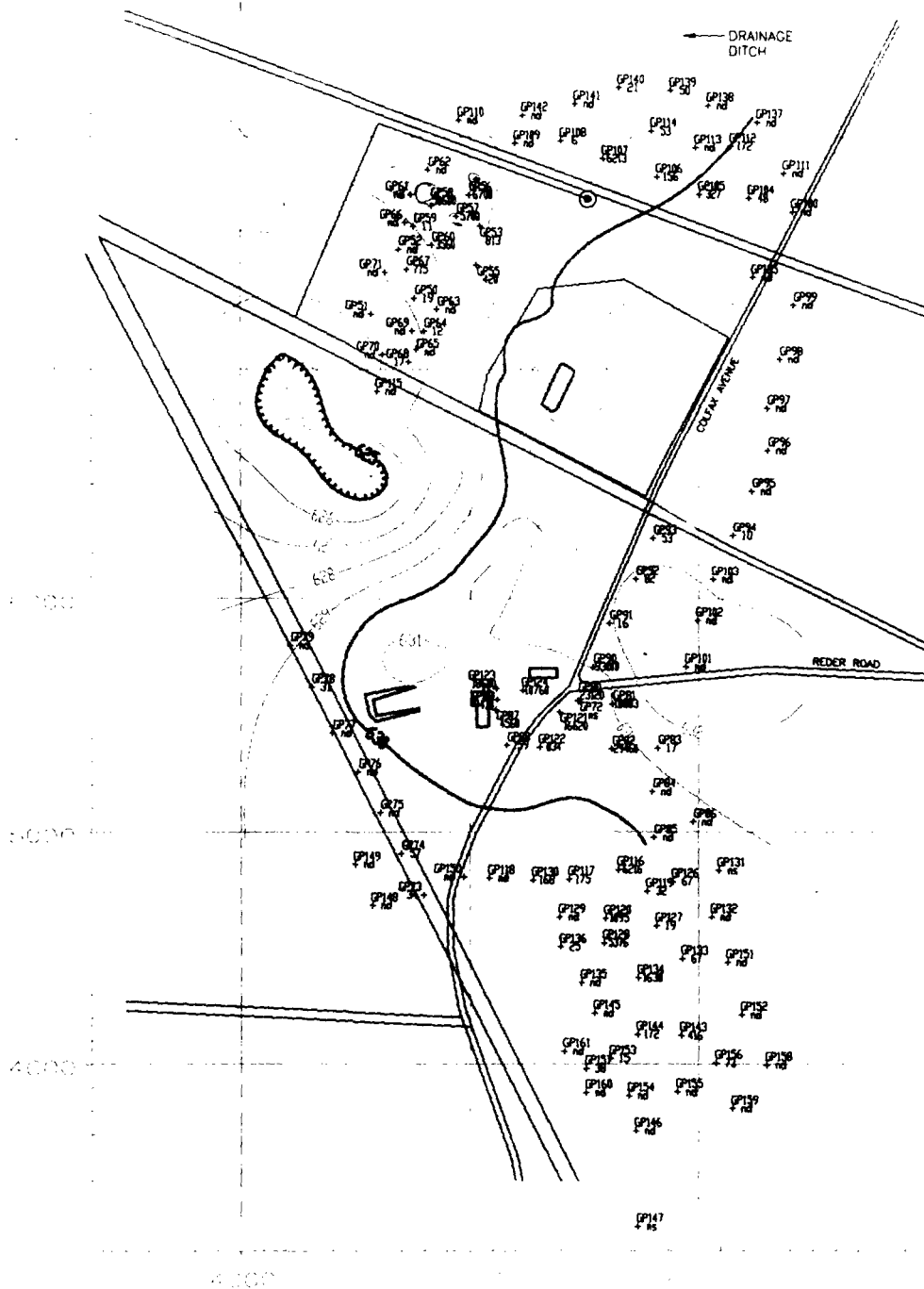


FIGURE 4

 MONTGOMERY WATSON	UPPER AQUIFER PLOT OF ACETONE DETECTIONS (ug/L)	Developed By <u>PV</u>	Drawn By <u>CCM</u>
	UPPER AQUIFER INVESTIGATION AMERICAN CHEMICAL SERVICE, INC. NPL SITE GRIFFITH, INDIANA	Approved By <u>PSV</u>	Date <u>5/4/96</u>
		Reference	
		Revisions	



LEGEND

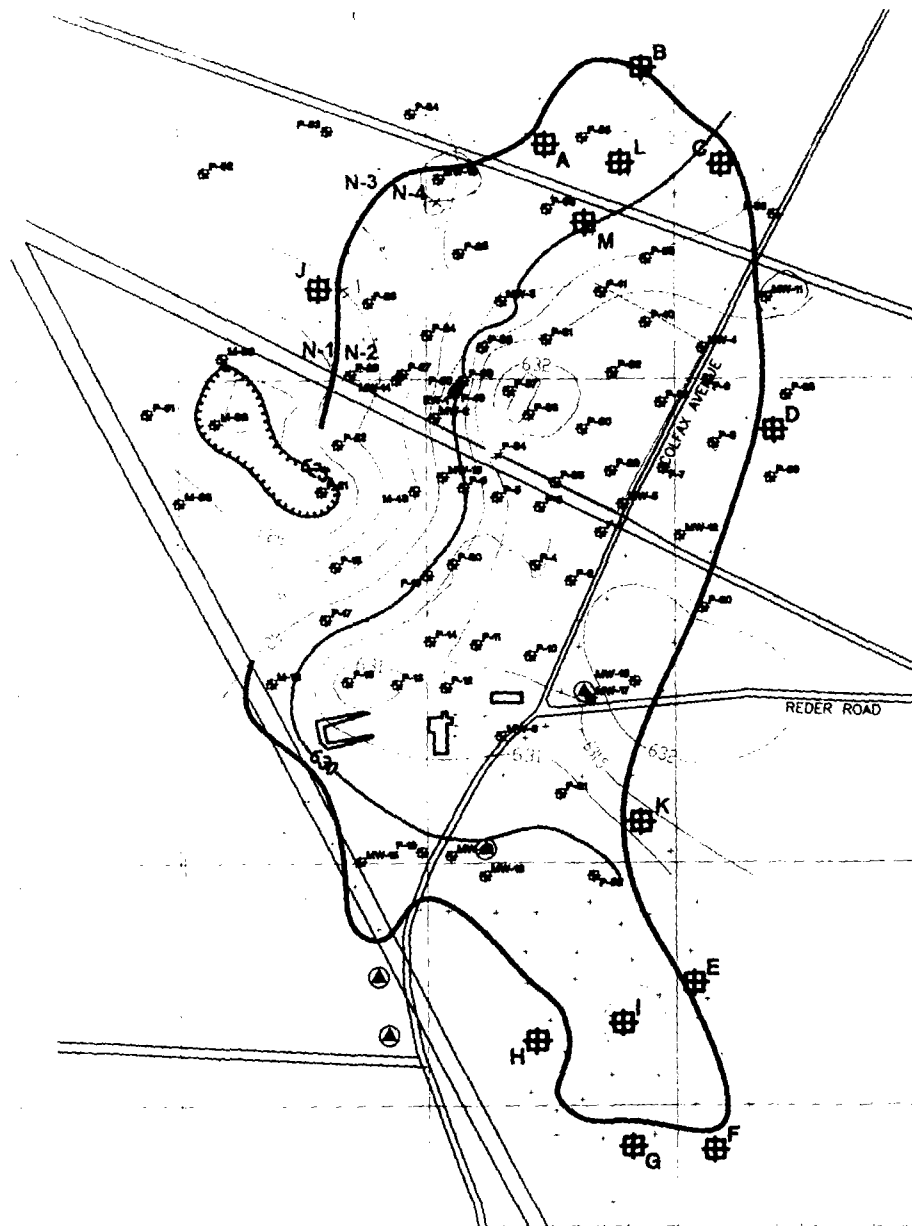
- GP100 GROUNDWATER SAMPLING POINT LOCATION AND NUMBER, WITH TOTAL VOLATILE ORGANIC COMPOUNDS (ug/L)
- SURFACE WATER SAMPLE
- nd NOT DETECTED
- ns NOT SAMPLED

NOTES

1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

FIGURE 5

	TOTAL VOC CONCENTRATIONS IN UPPER AQUIFER (ug/L) UPPER AQUIFER INVESTIGATION AMERICAN CHEMICAL SERVICE, INC. NPL SITE GRIFFITH, INDIANA	Developed By	pv	Drawn By	CCM
		Approved By	PSV	Date	5/3/96
		Reference			
		Revisions			



LEGEND

- PROPOSED UPPER AQUIFER MONITORING WELLS
- PROPOSED RESIDENTIAL WELL SAMPLES
- UPPER AQUIFER WELL LOCATION AND NUMBER
- LEACHATE/UPPER AQUIFER WELL LOCATION AND NUMBER
- PIEZOMETER LOCATION AND NUMBER
- GROUNDWATER SAMPLING POINT
- TOTAL VOC CONCENTRATIONS GREATER THAN DETECTION LIMITS

NOTES

1. GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

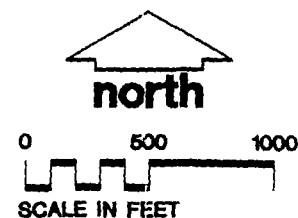


FIGURE 6

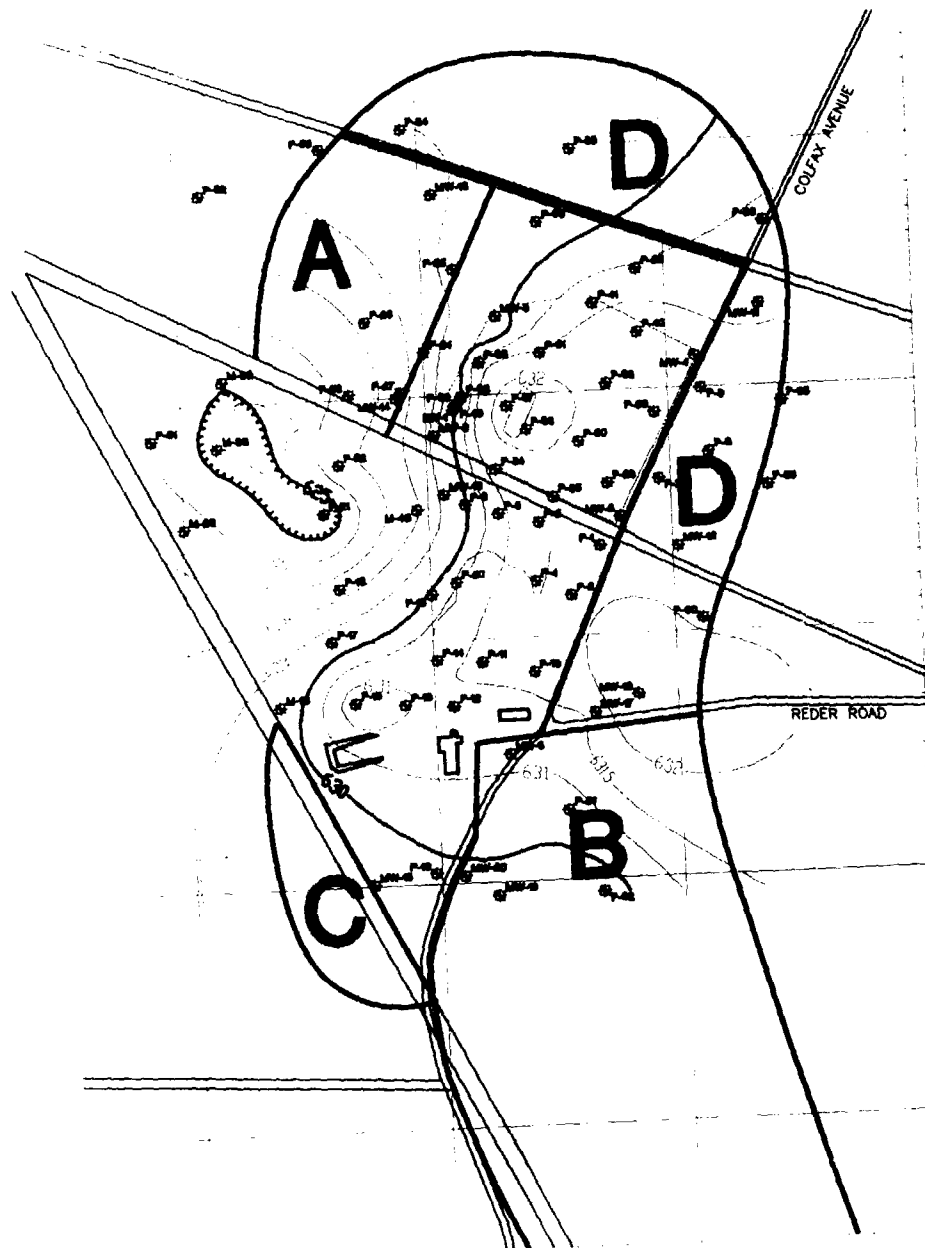
LOCATION OF PROPOSED MONITORING WELLS
AND RESIDENTIAL WELL SAMPLING

UPPER AQUIFER INVESTIGATION
AMERICAN CHEMICAL SERVICE, INC.
NPL SITE
GRIFFITH, INDIANA

Drawing Number
4077.0072 **B2**

**MONTGOMERY
WATSON**

Developed By: PV
Approved By: *RSV*
Reference:
Revisions:
Drawn By: CCM
Date: 5/3/96



LEGEND

- A LOCATION OF INVESTIGATION AREAS - SEE TEXT FOR FURTHER DESCRIPTION
- UPPER AQUIFER WELL LOCATION AND NUMBER
- LEACHATE/UPPER AQUIFER WELL LOCATION AND NUMBER
- ⊕ PIEZOMETER LOCATION AND NUMBER
- - - GROUNDWATER ELEVATION CONTOUR

NOTES

- GROUNDWATER LEVELS FOR WATER TABLE CONTOURS WERE MEASURED AT THE SITE ON OCTOBER 30, 1995.

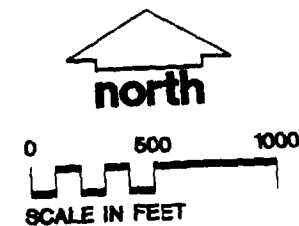


FIGURE 1

Developed By PV
 Drawn By CCM
 Date 5/3/96
 Approved By DV
 Reference
 Revisions

UPPER AQUIFER SAMPLING AREAS
 UPPER AQUIFER INVESTIGATION
 AMERICAN CHEMICAL SERVICE, INC.
 NPL SITE
 GRIFFITH, INDIANA

Drawing Number
 4077.0072 B1
 MONTGOMERY
 WATSON

ACCORD-08



A



A

TABULATION OF VOC ANALYSES
WITH FIELD GC

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP50	GP50A	GP51	GP51A	GPFB 1/24/96	GPTB 1/24/96	GP52	GP53	GP55	GP56
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	19	44						210	15	6700
1,1 Dichloroethene										
trans 1,2 Dichloroethene								23	5	
1,1 Dichloroethane										
2-Butanone (MEK)										
cis 1,2 Dichloroethene								7		
1,2 Dichloroethane										
1,1,1 Trichloroethane										
Benzene								550	400	
Carbon tetrachloride										
Trichloroethene										
4-Methyl-2-pentanone (MIBK)										
1,1,2 Trichloroethane										
Toluene								23		
Tetrachloroethene										
Chlorobenzene										
Ethylbenzene										
m+p Xylene										
Styrene										
o Xylene										
TOTAL VOCs (ug/L)	19	44	0	0	0	0	0	813	420	6700

Notes:
ug/L - Micrograms per liter
Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP57	GP58	GP59	GP60	GP61	GP62	GP63	GP64	GP65	GPTB 1/25/96
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	770	50600	11	3560				12		
1,1 Dichloroethene										
trans 1,2 Dichloroethene										
1,1 Dichloroethane										
2-Butanone (MEK)										
cis 1,2 Dichloroethene										
1,2 Dichloroethane										
1,1,1 Trichloroethane										
Benzene	5000									
Carbon tetrachloride										
Trichloroethene										
4-Methyl-2-pentanone (MIBK)										
1,1,2 Trichloroethane										
Toluene										
Tetrachloroethene										
Chlorobenzene										
Ethylbenzene										
m+p Xylene										
Styrene										
o Xylene										
TOTAL VOCs (ug/L)	5770	50600	11	3560	0	0	0	12	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GPFB 1/25/96	GP66	GP67	GP68	GP68 Dup	GP69	GP70	GP71		GP73
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone			715	16.9	20.8					34
1,1 Dichloroethene										
trans 1,2 Dichloroethene										
1,1 Dichloroethane										
2-Butanone (MEK)										
cis 1,2 Dichloroethene										
1,2 Dichloroethane										
1,1,1 Trichloroethane										
Benzene										
Carbon tetrachloride										
Trichloroethene										
4-Methyl-2-pentanone (MIBK)										
1,1,2 Trichloroethane										
Toluene										
Tetrachloroethene										
Chlorobenzene										
Ethylbenzene										
m+p Xylene										
Styrene										
o Xylene										
TOTAL VOCs (ug/L)	0	0	715	16.9	20.8	0	0	0	0	34

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP74	GPTB 1/26/96	GPFB 1/26/96	GP75	GP76	GP77	GP78	GPFB 1/31/96	GP79	GP80	GP81	GP82
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	57						31.1	13			1720	4450
1,1 Dichloroethene												
trans 1,2 Dichloroethene												
1,1 Dichloroethane												
2-Butanone (MEK)												
cis 1,2 Dichloroethene												
1,2 Dichloroethane			15.4					10.1		317	2770	3460
1,1,1 Trichloroethane											445	
Benzene										7860		3430
Carbon tetrachloride												
Trichloroethene												
4-Methyl-2-pentanone (MIBK)												
1,1,2 Trichloroethane												
Toluene										253	658	
Tetrachloroethene												
Chlorobenzene												
Ethylbenzene										3100	3110	4320
m+p Xylene										10800	10100	13800
Styrene												
o Xylene										790		
TOTAL VOCs (ug/L)	57.4	0	15.4	0	0	0	31.1	23.1	0	23120	18803	29460

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP83	GPTB 1/31/96	GP84	GP85	GP85 Dup	GP86	GPFB 2/1/96	GPTB 2/1/96	GP87	GP87 Dup	GP88
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone									3900	3000	159
1,1 Dichloroethene											
trans 1,2 Dichloroethene											
1,1 Dichloroethane											
2-Butanone (MEK)											
cis 1,2 Dichloroethene											
1,2 Dichloroethane		44.4									
1,1,1 Trichloroethane											
Benzene									410	420	
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene											
Ethylbenzene									250	260	
m+p Xylene	16.7									32	
Styrene											
o Xylene											
TOTAL VOCs (ug/L)	16.7	44.4	0	0	0	0	0	0	4560	3712	159

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP89	GPFB 2/5/96	GPTB 2/5/96	GPFB 2/6/96	GP90	GP91	GP92	GP93	GP94	GP95	GP96	GP97
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	2910				3960		81.5	42.7				
1,1 Dichloroethene												
trans 1,2 Dichloroethene												
1,1 Dichloroethane					940							
2-Butanone (MEK)					504							
cis 1,2 Dichloroethene					25700							
1,2 Dichloroethane									10			
1,1,1 Trichloroethane					226							
Benzene	1060				8260			5				
Carbon tetrachloride												
Trichloroethene												
4-Methyl-2-pentanone (MIBK)					8960	10.1						
1,1,2 Trichloroethane												
Toluene					18300							
Tetrachloroethene												
Chlorobenzene								5.6				
Ethylbenzene	1050				4530							
m+p Xylene	4450				18800	6.1						
Styrene												
o Xylene					2830							
TOTAL VOCs (ug/L)	9470	0	0	0	93010	16.2	81.5	53.3	10	0	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP98	GPTB 2/6/96	GP99	GP100	GP101	GP102	GP103	GP104	GPTB 2/6/96	GP105	GP106
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone								47.9		205	37.5
1,1 Dichloroethene										7.2	
trans 1,2 Dichloroethene											
1,1 Dichloroethane										20.1	
2-Butanone (MEK)											
cis 1,2 Dichloroethene										42.1	
1,2 Dichloroethane											
1,1,1 Trichloroethane											
Benzene										52.5	118
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene											
Ethylbenzene											
m+p Xylene											
Styrene											
o Xylene											
TOTAL VOCs (ug/L)	0	0	0	0	0	0	0	47.9	0	326.9	155.5

Notes:

ug/L - Micrograms per liter

Values in *italics* exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP107	GPFB 2/6/96	GPTB 2/7/96	GPFB 2/7/96	GPFB 2/7/96 Dup	GP108	GPFB 2/8/96	GP109	GP110	GP111
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	860									
1,1 Dichloroethene										
trans 1,2 Dichloroethene	14.3									
1,1 Dichloroethane										
2-Butanone (MEK)										
cis 1,2 Dichloroethene										
1,2 Dichloroethane				24	23.2					
1,1,1 Trichloroethane				12	12.3					
Benzene	5320									
Carbon tetrachloride										
Trichloroethene										
4-Methyl-2-pentanone (MIBK)	18.4					6.1				
1,1,2 Trichloroethane										
Toluene										
Tetrachloroethene										
Chlorobenzene										
Ethylbenzene										
m+p Xylene										
Styrene										
o Xylene										
TOTAL VOCs (ug/L)	6212.7	0	0	35.9	35.5	6.1	0	0	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP112	GP113	GP114	GP115	GPTB 2/8/96	GP116	GP117	GP118	GP119	GP120	GP121	GP122
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	172		53.3			240	175		16.6	719	4780	834
1,1 Dichloroethene												
trans 1,2 Dichloroethene												
1,1 Dichloroethane												
2-Butanone (MEK)												
cis 1,2 Dichloroethene												
1,2 Dichloroethane												
1,1,1 Trichloroethane												
Benzene						710			5.2	131	4580	
Carbon tetrachloride												
Trichloroethene												
4-Methyl-2-pentanone (MIBK)												
1,1,2 Trichloroethane												
Toluene												
Tetrachloroethene												
Chlorobenzene						49.6			10.6			
Ethylbenzene						666					635	
m+p Xylene						4550				245	6625	
Styrene												
o Xylene												
TOTAL VOCs (ug/L)	172	0	53.3	0	0	6215.6	175	0	32.4	1095	16620	834

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP123	GP124	GP125	GP126	GP127	GP127 Dup	GP128	GP129	GP130	GPTB 2/9/96	GPFB 2/12/96
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	6000	3810		51.4	13.4	28			168		
1,1 Dichloroethene											
trans 1,2 Dichloroethene											
1,1 Dichloroethane											
2-Butanone (MEK)											
cis 1,2 Dichloroethene											
1,2 Dichloroethane											
1,1,1 Trichloroethane											
Benzene	1590	6950				5.2	506				
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene				15.1	6	9					
Ethylbenzene											
m+p Xylene	2090						4870				
Styrene	8940										
o Xylene											
TOTAL VOCs (ug/L)	18620	10760	0	66.5	19.4	42.2	5376	0	168	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GPTB 2/12/96	GP57A	GP68A		GP132	GP133	GP133	GPFB 2/19/96	GPTB 2/19/96	GP134	GP135
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone		1400	348			61.6	58			412	
1,1 Dichloroethene											
trans 1,2 Dichloroethene											
1,1 Dichloroethane											
2-Butanone (MEK)											
cis 1,2 Dichloroethene											
1,2 Dichloroethane											
1,1,1 Trichloroethane											
Benzene		44700				5.1	5.1			1100	
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene										84.1	
Ethylbenzene										16.5	
m+p Xylene										16.1	
Styrene											
o Xylene											
TOTAL VOCs (ug/L)	0	46100	348	0	0	66.7	63.1	0	0	1628.7	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP136 (R)	GP137 (R)	GP138 (R)	GP139	GP139 Dup	GP140 (R)	GP141 (R)	GP142 (R)	GPFB 2/20/96	GPTB 2/20/96	GP52A
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	19.2			50.2	32.4	21.3					
1,1 Dichloroethene											
trans 1,2 Dichloroethene											
1,1 Dichloroethane											
2-Butanone (MEK)											
cis 1,2 Dichloroethene											
1,2 Dichloroethane											
1,1,1 Trichloroethane											
Benzene	5.3										
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene											
Ethylbenzene											
m+p Xylene											
Styrene											
o Xylene											
TOTAL VOCs (ug/L)	24.5	0	0	50.2	32.4	21.3	0	0	0	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP143	GP144	GP145	GPTB 2/21/96	GPFB 2/21/96	GP66A	GP70A	GP71A	GP146	GPTB 2/29/96
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	58.5									
1,1 Dichloroethene										
trans 1,2 Dichloroethene										
1,1 Dichloroethane										
2-Butanone (MEK)										
cis 1,2 Dichloroethene										
1,2 Dichloroethane										
1,1,1 Trichloroethane										
Benzene	252	172								
Carbon tetrachloride										
Trichloroethene										
4-Methyl-2-pentanone (MIBK)										
1,1,2 Trichloroethane										
Toluene										
Tetrachloroethene										
Chlorobenzene										
Ethylbenzene										
m+p Xylene	105									
Styrene										
o Xylene										
TOTAL VOCs (ug/L)	415.5	172	0	0	0	0	0	0	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96		GP148	GP149	GP150	GP151	GP152	GP153	GPFB 3/1/96	GPTB 3/1/96	GP154	GP155
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone							15				
1,1 Dichloroethene											
trans 1,2 Dichloroethene											
1,1 Dichloroethane											
2-Butanone (MEK)											
cis 1,2 Dichloroethene											
1,2 Dichloroethane											
1,1,1 Trichloroethane											
Benzene											
Carbon tetrachloride											
Trichloroethene											
4-Methyl-2-pentanone (MIBK)											
1,1,2 Trichloroethane											
Toluene											
Tetrachloroethene											
Chlorobenzene											
Ethylbenzene											
m+p Xylene											
Styrene											
o Xylene											
TOTAL VOCs (ug/L)	0	0	0	0	0	0	15	0	0	0	0

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

Appendix A
Summary of Upper Aquifer Field Screening Results
American Chemical Service, Inc.
Griffith, Indiana

chk'd to 3/14/96	GP156	GP157	GP158	GP159	GP160	GP161	GPFB 3/4/96	GPTB 3/4/96	SW101
Compound - Field GC	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	34	38			<20				
1,1 Dichloroethene									
trans 1,2 Dichloroethene									
1,1 Dichloroethane									
2-Butanone (MEK)									
cis 1,2 Dichloroethene									
1,2 Dichloroethane									
1,1,1 Trichloroethane									
Benzene	38.8								1180
Carbon tetrachloride									
Trichloroethene									
4-Methyl-2-pentanone (MIBK)									
1,1,2 Trichloroethane									
Toluene									
Tetrachloroethene									
Chlorobenzene									
Ethylbenzene									
m+p Xylene									
Styrene									
o Xylene									
TOTAL VOCs (ug/L)	72.8	38	0	0	0	0	0	0	1180

Notes:

ug/L - Micrograms per liter

Values in Italics exceeded the Calibration linear range at the dilution analyzed.

B



B

FIELD GC PRINTOUTS AND PLOTS
(AVAILABLE UPON REQUEST)

C

UPPER AQUIFER INVESTIGATION SOPs

SPECIFIC OPERATING PROCEDURES

American Chemical Service Inc.

Griffith, Indiana

MONITORING WELL DEVELOPMENT PROTOCOL

Subject: Monitoring Well Development

Method: Surge and Purge using submersible pump

Well development should not occur within 24 hours after well construction if annular space is grouted. Grout must set up prior to development.

I. PRE-FIELD CHECKLIST

A. Paperwork to take to the site

1. Completed monitoring well construction field QC summary for the wells to be developed
2. Completed monitoring well construction summary for the wells to be developed
3. Monitoring well development summary forms
4. Health and Safety Plan

B. Equipment to take to the site

1. Field Notebook
2. Plastic sheeting
3. Electronic water level indicator
4. 5 gallon bucket
5. Plan for disposal of water
6. Decon solutions
7. pH meter
8. Specific conductance meter
9. Turbidity meter
10. Pumps (GRUNDFOS)
11. PVC or stainless steel bailer
12. Hand tools (socket set, hammer)

13. Sample bottles and preservatives
14. Well access (keys, flushmount access, off-site property access agreement)
15. Drums or poly tank for containing purge water

II. FIELD CHECKLIST

- A. Well Labeled?
- B. Surficial seal in good shape?
- C. Flushmount cover and protective cover in good shape?
- D. Lock in good shape? Lubricated with graphite?
- E. Sand drainage inside flushmount or protective casing?
- F. Vent hole in well cap? (stick up wells)
- G. Water tight cap loosened, water level equilibrated? (flushmount wells)
- H. Weep hole in protective casing?

III. WELL DEVELOPMENT

- A. Measure depth to water from top of the well casing with an electronic water level indicator.
- B. Measure total depth from top of well casing with an electronic water level indicator.
- C. Compare measured total well depth with total well depth reported on the QC summary. The difference is the amount of sediment in the well bottom.
- D. Calculate the total volume of water contained in the well plus the volume of water in the sand pack:

Total Volume = well volume + sand pack volume

Well Volume (gallons) = $0.16(r^2)(L)$

Where r = inside well radius in inches

L = length of water column in feet

Sand Pack Volume (Gallons) = $0.057(R^2 - r^2)L$

Where R = borehole radius in inches

r = outside well radius in inches

L = saturated length of sand pack in feet
(assumes sand pack porosity of 35%)

- E. Alternately surge and purge the well using a PVC/stainless steel bailer or submersible pump. Let the bailer or pump sink to the well bottom. Forcefully pull it up through the screen length and let it settle back to the bottom. This agitation suspends sediment in the well bottom and moves fines in and out of the well screen. If using a bailer, pull out the bailer and discharge the water into a 5 gallon bucket. If using a submersible pump, allow the pump to purge water into a 5 gallon bucket during the surging

process. Note the color, odor, and turbidity of the purge water in the field notebook. Repeat this surge and purge cycle for about 20-30 minutes.

- F. After surging and purging for 20-30 minutes, purge three well and sand pack volumes from the well using a submersible pump (GRUNDFOS) or bailer. A submersible pump will be used if a sustainable flow rate from the well can be achieved. If the well is purged dry, a pump or bailer may be used for development. A well which purges dry is one that can be pumped down to the bottom and does not recover 50% of the well volume within 30 minutes.
- G. For wells that cannot be purged dry, the purge water will be tested for pH, specific conductivity, temperature, and turbidity at regular volume intervals after three well and sand pack volumes have been initially removed. If, after purging five well and sand pack volumes from the well, the readings of pH, specific conductivity, temperature, and turbidity are stabilized within 10% over three consecutive measurements, well development will be completed for the well. If parameter measurements have not stabilized within 10%, purging will continue until either stabilization has been achieved or a maximum of 10 well and sand pack volumes have been removed from the well.
- H. For wells that purge dry, slowly purge the well using a pump or bailer. The purge water will be tested for pH, specific conductivity, temperature and turbidity at the end of each well plus sand pack volume. If possible, three to five well and sand pack volumes will be removed. Return trips to the well on the same day, or overnight may be necessary.
- I. If a submersible pump is used for purging, do not allow the pump to rest stationary at the well bottom. If the pump motor is positioned at the base of the pump, resting the pump at the bottom of the well will not let water flow around the motor, potentially allowing the motor to overheat. The maximum sustainable pumping rate utilized during purging will be measured by determining the length of time required to fill a 5-gallon bucket. This information will be recorded in the field notebook.

IV. MANAGEMENT OF DEVELOPMENT WATER

- A. Purge water will be contained by pumping purge water into drums (steel or plastic) at each well location, or by pumping into a plastic holding tank located on the back of a pick up truck. If the water is contained in drums, the drums will be moved to the off-site containment area for staging following completion of well development activities. If the water is contained in the plastic tank during purging, the tank will then be removed to the off-site containment area and the water will be pumped into drums and staged for future disposal. Water will be carefully pumped into the drums with enough space left in the drums to allow for freezing of water without causing the drums to crack, or leak.

V. EQUIPMENT DECONTAMINATION

A. Development equipment (bailer, submersible pump, pump tubing) will be decontaminated between monitoring wells as follows:

- Wash with water and nonphosphate detergent (Alconox)
- Rinse with tap water
- Rinse with distilled water

B. Water generated during decontamination will be collected and containerized in 55-gallon drums. The drums will then be sealed, labeled and stored in the off-site containment area for future disposal.

V. DOCUMENTATION

A. Monitoring Well Development Summary

1. Record method of surging and purging, time spent developing and total volume purged into field notebook.
2. Record time, pH, specific conductivity, temperature, and turbidity measurements into field notebook.
3. For wells where development was conducted with a submersible pump, record the maximum pumping rate used.

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SPECIFIC OPERATING PROCEDURES

UPPER AQUIFER INVESTIGATION

American Chemical Service Inc.

Griffith, Indiana

PRIVATE WELL SAMPLING

Scope and Application: To provide guidelines for collection of private well water samples.

Reagents and Apparatus:

1. Assorted tools
2. Sample containers, sample labels
3. Chain-of-Custody forms
4. Cooler with ice

Procedure:

1. Schedule sampling with residential property owners.
2. Label all sample containers prior to collection.
3. Locate the untreated, cold water source as near to the well head as practicable. If possible, the sample should be collected directly off the tap between the pump and the pressure tank. Verify that the sample has not passed through any type of treatment system (water softener, iron filter, hot water heater, etc.). Record the exact location the sample was taken.
4. If a sampling location cannot be located directly off the pressure tank or from a tap between the pump and the pressure tank the following sampling procedure should be used:

The well/pressure tank system should be purged by allowing the water to run for a minimum of ten minutes, or until the pump has cycled at least once. After the water has run for ten minutes, or the pump has cycled it can be assumed that the running water represents new formation water and a sample can be collected for analysis.

5. Fill appropriate containers for laboratory analysis.

6. Clean up sampling area if necessary.

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SPECIFIC OPERATING PROCEDURES

American Chemical Service Inc.

Griffith, Indiana

GROUNDWATER MONITORING WELL SAMPLING

Subject: Groundwater Monitoring Well Sampling

Method: Low Flow Sampling with Submersible Pump

I. PRE-FIELD CHECKLIST

A. Paperwork to take to the site

1. Completed monitoring well construction summary for the wells to be sampled
2. Monitoring well development summary forms
3. Health and Safety Plan

B. Equipment to take to the site

1. Field Notebook
2. Watch, or timing device
3. Electronic water level indicator
4. 5-gallon bucket
5. Plan for disposal of water
6. Decon solutions and buckets
7. pH meter
8. Specific conductance meter
9. Turbidity meter
10. Pump (Grundfos), generator, extension cord (50 feet)
11. Polyethylene tubing, hose clamps
12. Graduated container
13. Hand tools (socket set, hammer)
14. Sample bottles (EPA540/R93/051/Dec/92) and preservatives (HCL and HNO₃)
15. Sample labels and tags
16. Well access (key)
17. Drums or poly tank for containing purge water
18. Cooler(s) with ice

19. Packing material (vermiculite, tape)
20. Chain of custody forms

II. LOW FLOW SAMPLING WITH SUBMERSIBLE PUMP

- A. Measure and record depth to water from top of the well casing with electronic water level indicator. Examine the water level indicator for evidence of sheen, oily surface or other immiscible fluids and record this information in the field log book.
- B. Measure and record total depth from top of well casing with electronic water level indicator.
- C. Refer to monitoring well construction summary for depth to top of the well screen. Attach new, clean polyethylene tubing to the Grundfos pump. (Teflon® tubing was considered for sampling purposes but not selected due to its excessive rigidity which makes the tubing difficult to attach to the pump and handle while raising and lowering the pump in the well. This material is more ideally suited and typically utilized for dedicated well sampling systems, including bladder pumps or Waterra inertial lift pumps).
- D. Lower the Grundfos pump so that the pump rests approximately one foot above the well screen.
- E. Begin purging the well at a rate of approximately 300 ml per minute. Confirm the purge rate by measuring the amount of water purged in one minute with a graduated measuring device, such as a bucket, or sample container. Observe the purge water for evidence of a sheen, oily surface or other immiscible fluids and record this information in the field log book.
- F. While purging, field measurements for pH, specific conductance, temperature, and turbidity will be monitored. Measurements of pH, specific conductance, and temperature will be collected in-line or by inserting instrument probes into a bypass stream of water from continuous pump discharge. The bypass stream will be directed into a sample container (250 ml poly jar) for parameter measurement. Turbidity measurements will be collected from the bypass stream into its own collection and measurement device.
- G. When pH, specific conductivity, temperature, and turbidity readings have stabilized for three consecutive readings within 10% of the previous readings, sample bottles can then be filled. Samples collected for volatile organic analyses shall be filled first. Samples shall be placed in a cooler and iced immediately after collection.
- H. Purge water will be contained by placing purge water into drums (steel or poly) at each well location, or by pumping into a poly holding tank which can be

placed onto the back of a pickup truck. The purge water will be stored at the off-site containment area for staging following completion of sampling activities. If the water is contained in the poly tank during purging, the tank will then be moved to the off-site containment area and the water will be pumped into drums and staged for future disposal. Water will be carefully pumped into the drums with enough space left in the drums to allow for freezing of water without causing the drums to crack or leak.

- I. Upon completion of the sampling event, promptly remove the sampling pump from the well and decontaminate the pump by inserting the pump into a 5-gallon bucket prepared with a distilled water and Aloconox solution, followed by a distilled water rinse. Water generated during decontamination will be collected and containerized in 55-gallon drums. The drums will then be sealed, labeled and stored in the off-site containment area for future disposal.

III. SAMPLE LABELING AND TAGGING

- A. Sample labels and tags are used in conjunction with chain-of-custody documents to ensure sample identification, preservation, and custody requirements are maintained. Each label and tag will be labeled with a sample identifier code as defined below.

A three letter designation will be used for identifying the sampling site. The project identifier will be "APD," to signify the American Chemical Service, Inc. NPL site during the pre-design investigation.

Each groundwater sample will be identified by a two letter code, "GW" to identify the sample as a groundwater sample from a monitoring well.

The sample type code will be followed by a 2-5 digit alpha-numeric code to indicate sample location. This code will correspond to monitoring well number (i.e., MW34).

For example, a groundwater sample collected from monitoring well MW-35 will have the following sample label: APD-GW-MW35.

- B. Adhesive labels are used to identify all samples collected by Montgomery Watson personnel during field activities with the exception of samples collected for submittal to laboratories through the U.S. EPA Contract Laboratory Program (CLP) (federal lead investigation).

The adhesive label should be affixed to the sample container prior to sample collection. Condensation may form on containers after filling which would make it difficult to adhere labels.

U.S. EPA Sample Tags are used to identify all samples collected under the U.S. EPA Contract Laboratory Program (CLP). Tags are affixed to each to the bottles using a loop around the neck of the bottle. The information on the sample tag is filled in completely, with the sample identifier code described above.

IV. SAMPLE COLLECTION AND PREPARATION

A. All sample containers received from the laboratory will meet the specifications and protocols of U.S. EPA guidance document EPA540/R-93/051/12-92.

B. Volatile Organic Compounds

1. Remove the plastic cap and Teflon®coated septum being careful not to contact potential contaminants. If vial and/or cap appears to be defective, discard and use a new vial. The vial should be opened for a minimum amount of time. Three (3) vials must be collected for each sample.
2. Carefully fill the vial with continuous low flow from the pump with water until meniscus (mound of water) forms on the top. Avoid agitating the sample as this may cause a loss of volatiles. Add four drops of 1+1 hydrochloric acid (HCL) to the sample for preservation. HCL preservation may be added to the vial either before or after sample collection.
3. Carefully replace the cap on the meniscus. This will force a small amount of water off the top. Check the vial for air bubbles by inverting vial and gently tapping the side of the vial. Bubbles will rise to the top, if present. If bubbles are present, discard the vial and start with a new one. Place samples into cooler with ice upon sample completion.

C. Semi-volatiles and PCBs

1. For sampling of semi-volatile organic compounds and PCBs, two 1-liter amber glass bottles for each parameter are to be filled to the shoulder. Sampling should continue to be performed at the low flow purge rate of 300 ml per minute.
2. No preservation is required for either semi-volatiles or PCBs. Therefore, upon completion of filling sampling bottles, immediately place the bottles in a cooler with ice.

D. Metals (Dissolved and Total Metals)

Unfiltered Metals (Total Metals)

1. Continue to purge well at 300 ml per minute. Fill 1-liter polyethylene container to the shoulder. Preserve with 3 ml, or until pH<2, of HNO₃. Place sample into cooler with ice.

Filtered Metals

1. While continuing to purge at 300 ml per minute, fill a 1-liter polyethylene container with the water sample. Use a peristaltic pump or hand pump with an attached 0.45 micron in-line filter to pump water from the polyethylene container, through the filter, into the appropriate sample container (1-liter polyethylene).
2. Once the container has been filled, add 3.0 ml, or until pH<2, of 1:1 Nitric acid (HNO₃) per 1 liter of sample. Sample should be filtered and preserved as quickly as possible after collected, generally within 20 minutes of sample collection. Place sample into cooler with ice.

V. DOCUMENTATION

A. Field Notebook

All sample collection activities will be documented in the field log book. The field log book will contain the following information:

1. Sampling location
2. Sample identification number
3. Date and time of collection
4. Depth to water
5. Purging rate and approximate volume purged
6. Field parameter measurements
7. Type(s) of sample containers
8. Field observations (weather, odor, sheen, etc.)
9. Name of sampling personnel
10. Preservation method
11. Analyses requested

B. Chain-of-Custody (COC) Forms

1. The COC record will be used to document the samples taken and analyses requested. Information that field personnel will record on the COC record includes the following:
 - a. Project name
 - b. Sampling location
 - c. Printed name and signature of sampler
 - d. Sample identification number
 - e. Sample label number

- f. Date and time of collection
 - g. Sample designation (QA/QC, grab or composite)
 - h. Sample matrix
 - i. Number and size of containers
 - j. Analyses requested
 - k. Signature of individual involved with custody transfer (including date and time of transfer)
2. COC records initiated in the field will be signed, placed in a plastic "zip-lock" bag, and secured inside of the shipping container used for sample transport. Signed air bills will serve as evidence of custody transport between the field sampler and courier as well as the courier and laboratory. Copies of the COC record and the air bills will be retained and filed by the sampler prior to shipment.

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SPECIFIC OPERATING PROCEDURES

UPPER AQUIFER INVESTIGATION

American Chemical Service Inc.

Griffith, Indiana

GROUNDWATER MONITORING WELL INSTALLATION PROTOCOL

Scope and Application: This method is applicable to installing upper aquifer groundwater monitoring wells.

I. PRE-FIELD CHECKLIST

- A. Health and Safety Plan with related instruments
- B. Underground Utility Check: 5 to 7 day advance notice required
- C. Off-Site access agreements completed
- D. Statement of Work detailing sample types, sample intervals, drilling and sampling methods
- E. Field boring logs (Montgomery Watson Standard)
- F. Daily Drilling Summary
- G. Unified Soil Classification System summary
- H. Decon solutions, brushes, buckets
- I. Soil jars (Laboratory Grade and Driller's Grade)
- J. Jar labels
- K. Driller contacted and informed
 - 1. Health and Safety Plan
 - 2. Utility check
 - 3. Statement of Work/Sampling Plan
- M. 150 foot tape measure

- N. Pocket penetrometer
- O. Soil knife/spatula
- P. Utility Knife
- Q. Well Construction Forms
- R. Well Development Forms

II. FIELD CHECKLIST

- A. Check for unmarked or uncleared utilities, drive around, walk around
- B. Check for overhead wires
- C. Drill rig access
- D. Health and Safety Briefing
- E. Borehole location correctly staked and labeled
- F. Steam clean drill rods, casing, bits, split-spoon samplers, hand tools, drill rig
- G. Count number of drill rods to determine the number used during drilling and therefore, the total depth drilled
- H. Confirm the correct well construction materials are present
- I. Prepare soil jars

III. SOIL BORINGS

Soil borings will be advanced using 4.25 inch inner diameter (ID) hollow stem augers (HSA). Soil samples will be collected using a 2-inch diameter split-spoon sampler at 2.5 ft sampling intervals (i.e. 1 to 2.5 feet, 3.5 to 5 feet, etc.). Soil samples collected will be visually inspected and classified according to the Unified Soil Classification System (USCS).

- A. Split Spoon Sampling
 - 1. Inspect split spoon

- a. Measure length of spoon from tip to shoe.
- b. Spoon tip must not be gouged, bent, or excessively worn
- c. Spoon must have a check valve; the check valve should be free of soil and be able to seal.
- d. Spoon tip may contain a spring sample catcher which is clean and in good working order.
- e. Split spoon samplers should be cleaned between boring locations using steam cleaning. Split spoons will be washed between sampling intervals using a TSP/Liquinox wash followed by a distilled water rinse

2. Handling Split Spoon Sample - Logging Soils

- a. Carefully open split spoon sampler. Do not slam the split spoon to open.
- b. Recognize and disregard any soil plug, sluff, or blow-in at the upper portion of the sample.
- c. Measure and record sample recovery.
- d. Perform pocket penetrometer test on cohesive soils if encountered.
- e. Describe and record the soil sample in accordance with the Unified Soil Classification System (USCS).

- 3. At a minimum, split spoon sampling will be advanced two feet into the clay confining layer.

IV. INSTALLATION OF MONITORING WELLS

Monitoring wells are constructed of 2 inch diameter stainless steel material, and fitted with ten foot screens.

The elevation to place the screen will be based on the depth to the water table at each location. Typical water table monitoring wells are screened so that 2 to 3 ft of the top of the well screen is installed above the unsaturated zone to allow for water table fluctuation. In areas where the water table is high (areas of standing water, wetlands, etc.), each well will be screened so that a minimal seal can be installed. If the water table is within 3 feet of the ground surface, the monitoring wells will be installed such that the bottom of the well screen is set at approximately 13 ft. This

will bring the top of the well screen to approximately 3 ft below ground surface, which will allow for a bentonite seal. Each monitoring well or piezometer will be installed through the 4.25 inch inner diameter hollow stem augers that was used to advance the borehole to its desired depth.

A. Before Well Installation

1. Inspect screen and riser pipe inside and out for cleanliness, defects, gouges, cracks: reject any failed pieces.
2. Accurately measure length of screen piece including blank sections.
3. Measure total length of slotted interval
4. Accurately measure length of each riser piece.
5. Count the number of riser pieces to confirm accurate total length of well.
6. Inspect filter pack material: proper gradation, proper material, contaminant free, sufficient quantity.
7. Inspect bentonite chips or pellets: Bentonite chips or pellets should be 3/8" in size.

B. During Well Installation

1. Determine depth of well placement as total length of assembled well string minus height of well string to above ground surface.
2. Riser pieces should have water tight joints: either neoprene gaskets or Teflon tape. Do not use glue or solvent cement.
3. Accurately determine total well depth.
 - a. Measure length of well riser pipe piece cut off from the total length of well string.
 - b. Total well string length minus length of cut off piece equals total well depth (TD) measured from top of casing (TOC).
 - c. The well top should stick up a minimum of 24 inches above the ground surface.
4. Install a temporary well cap to prevent any materials from falling into the well. Lower well string down into the casing to the predetermined depth.
5. Filter pack construction

- a. Introduce a well graded sand in a controlled manner: slowly add filter sand. Slowly retract the hollow stem augers surrounding the screen.
 - b. Filter pack will extend from 6 inches below the well bottom to 2 feet above the top of the well screen, if possible. In areas where the water table is close to ground surface (generally within 3 ft of the ground), 1 ft of filter pack above the screen is essential so that a seal can still be installed.
 - c. Periodically use tape measure to check for bridging and to show height of filter pack in comparison to the well screen.
6. Bentonite Seal:
 - a. Use bentonite chips or pellets no larger than 3/8 inch in diameter when placing seal through water.
 - b. Place minimum two feet of bentonite seal above the filter pack.
 - c. Place 6 inches of fine sand on top of the bentonite seal
 - d. Record the type, size, and volume of sealant placed.
7. Annular Space Seal. All permanent monitoring wells will have an annular space seal which extends from the top of the filter pack seal to the bottom of the ground surface seal and will have a minimum two foot length.
 - a. For water table wells with the water table at 7 feet or less below ground surface, use granular bentonite only; place the bentonite in 2 foot lifts, hydrating each lift
 - b. Use granular bentonite.
 - (1) When there is no standing water in the borehole and the placement depth is less than 25 ft.
 - (2) The depth to the water table is less than 7 ft. below ground surface.
 - c. Record type and volume of annular space seal.
8. Construct ground surface seal. Check for annular space seal settlement. If grout or slurry is used as the annual space seal, wait 24 hours after seal installation before installing the surface seal. If the water table is within 7 ft of the ground surface, surface seal may installed after the bentonite seal has been placed above the filter pack.
 - a. Stick up well protective pipe.
 - (1) Measure the length of well protective pipe.

- (2) Subtract well stick up height to get embedment depth of well protective pipe.
- (3) If the well protective pipe embedment depth intersects the filter pack or filter pack seal, then shorten the length of the well protective pipe. The minimum embedment depth should not be less than the stick up height. If the water table is within 7 ft of the ground surface, this may be modified so that the minimum embedment is less than the stick up height.
- (4) The ground surface seal will start at least 5 ft. below ground surface, if the water table depth is at least 7 ft below ground surface. However, if the depth to water is less than 7 ft, the ground surface seal will be set at a minimum of 1 ft above the top of the well screen so that the protective casing does not intersect the well screen.
- (5) Place bentonite chips, pellets or granules up to 1 ft. below the well protective pipe embedment depth, then place 1 ft. of filter sand.
- (6) Set the well protective pipe onto the firm bed of filter sand.
- (7) Add granular bentonite around the outside of the protective pipe only and hydrate it to 2 ft. lifts to the surface.
- (8) Concrete ground surface seals in regions where the ground freezes are not recommended. Frost heave will jack the concrete seal and the well protective pipe out of the ground.
- (9) Do not place bentonite between the protective pipe and the well casing.
- (10) If the monitoring well depth is such that both a minimum 2 ft. annular space seal and a minimum 5 ft. ground surface seal cannot both be placed, the ground surface seal may be shortened.
- (11) Record the depth to the bottom of the ground surface seal, also record the length and diameter of the well protective pipe.
- (12) The well protective pipe should stick up a minimum of 24 in. above the ground surface and should always extend above the top of the well.

- (13) The top of the well pipe must be within 4 in. of the top of the well protective pipe.
- (14) The well protective pipe should not extend into the filter pack.
- (15) The well protective pipe should be filled with filter sand to within 12 in. of the top of the well.
- (16) A weep hole may be drilled into the well protective pipe; a small vent hole should be cut or drilled into the well cap.

C. After Well Installation

- 1. Check for settlement of the ground surface seal; top off as necessary.
- 2. Label the protective casing with the well number.
- 3. Stick up wells: label the well cap inside and out with the well number.
- 4. Lubricate the well lock.
 - a. Do not use WD-40 or penetrating oils.
 - b. Remove the lock away from the well and lubricate it with liquid graphite.
 - c. Wipe off excess lubricant, allow the lock to "dry", then return it to the well.
- 5. Stick up wells in high traffic areas: consider placing bumper posts around the well.
 - a. Wood or steel, set in concrete or bentonite.
 - b. At least 8 ft. long with 4 ft. stick up.
 - c. Posts may be painted or flagged.
 - d. Do not paint the well protective casing.
- 6. Clean up the area: pick up trash, do not burn; pick up cuttings; use a broom, rake, or hose down the area.

SPECIFIC OPERATING PROCEDURES

UPPER AQUIFER INVESTIGATION

American Chemical Service Inc.

Griffith, Indiana

PIEZOMETER INSTALLATION PROTOCOL

Scope and Application: This method is applicable to installing piezometers.

I. PRE-FIELD CHECKLIST

- A. Health and Safety Plan with related instruments
- B. Underground Utility Check: 5 to 7 day advance notice required
- C. Off-Site access agreements completed
- D. Statement of Work detailing sample types, sample intervals, drilling and sampling methods
- E. Field boring logs (Montgomery Watson Standard)
- F. Daily Drilling Summary
- G. Unified Soil Classification System summary
- H. Decon solutions, brushes, buckets
- I. Soil jars (Laboratory Grade and Driller's Grade)
- J. Jar labels
- K. Driller contacted and informed
 - 1. Health and Safety Plan
 - 2. Utility check
 - 3. Statement of Work/Sampling Plan
- M. 150 foot tape measure
- N. Pocket penetrometer

- O. Soil knife/spatula
- P. Utility Knife
- Q. Well Construction Forms
- R. Well Development Forms

II. FIELD CHECKLIST

- A. Check for unmarked or uncleared utilities, drive around, walk around
- B. **Check** for overhead wires
- C. Drill rig access
- D. Health and Safety Briefing
- E. Borehole location correctly staked and labeled
- F. Steam clean drill rods, casing, bits, split-spoon samplers, hand tools, drill rig
- G. Count number of drill rods to determine the number used during drilling and therefore, the total depth drilled
- H. Confirm the correct well construction materials are present
- I. Prepare soil jars

III. SOIL BORINGS

Soil borings will be advanced using 4.25 inch inner diameter (ID) hollow stem augers (HSA). Soil samples will be collected using a 2-inch diameter split-spoon sampler at 2.5 ft sampling intervals (i.e. 1 to 2.5 ft, 3.5 to 5 ft, etc). Soil samples will be visually inspected and classified according to the Unified Soil Classification System (USCS).

- A. Split Spoon Sampling
 - 1. Inspect split spoon
 - a. Measure length of spoon from tip to shoe.

- b. Spoon tip must not be gouged, bent, or excessively worn
 - c. Spoon must have a check valve; the check valve should be free of soil and be able to seal.
 - d. Spoon tip may contain a spring sample catcher which is clean and in good working order.
 - e. Split spoon samplers should be cleaned between boring locations using steam cleaning. Split spoons will be washed between sampling intervals using a TSP/Liquinox wash followed by a distilled water rinse.
2. Handling Split Spoon Sample - Logging Soils
- a. Carefully open split spoon sampler. Do not slam the split spoon to open.
 - b. Recognize and disregard any soil plug, sluff, or blow-in at the upper portion of the sample.
 - c. Measure and record sample recovery.
 - d. Perform pocket penetrometer test on cohesive soils, if encountered.
 - e. Describe and record the soil sample in accordance with the Unified Soil Classification System (USCS).
3. At nested locations, the first borehole will be drilled and sampled to at least two-feet into the clay confining layer which underlies the surficial sand aquifer. Additional boreholes will be blind drilled to the required depth for well/piezometer installation.

IV. INSTALLATION OF PIEZOMETERS

Piezometers are constructed of either 2-inch or 1.5-inch diameter PVC material, and fitted with two-foot screens (piezometers installed to the base of the surficial aquifer) and five-foot screens (piezometers installed to intersect the water table).

Piezometers will be installed through 4.25-inch ID hollow stem augers. Piezometers installed to the base of the surficial aquifer will be constructed using 2-foot screens, with the screened interval extending to the base of the surficial sand aquifer. Water table piezometers will be constructed using five-foot screens installed to intersect the water table (i.e., the well screen will be placed so that approximately 2 feet of the well screen length is above the water table measured in the borehole).

A. Before Piezometer Installation

1. Inspect screen and riser pipe inside and out for cleanliness, defects, gouges, cracks: reject any failed pieces.
2. Accurately measure length of screen piece including blank sections.
3. Measure total length of slotted interval
4. Accurately measure length of each riser piece.
5. Count the number of riser pieces to confirm accurate total length of well.
6. Inspect bentonite chips or pellets: Bentonite chips or pellets should be 3/8" in size.

B. During Piezometer Installation

1. Determine depth of piezometer placement as total length of assembled well string minus height of well string to above ground surface.
2. Riser pieces should have water tight joints: either neoprene gaskets or Teflon tape. Do not use glue or solvent cement.
3. Accurately determine total piezometer depth.
 - a. Measure length of riser pipe piece cut off from the total length of well string.
 - b. Total well string length minus length of cut off piece equals total piezometer depth (TD) measured from top of casing (TOC).
 - c. The well top should stick up a minimum of 24 inches above the ground surface.
4. Install a temporary cap to prevent any materials from falling into the piezometer. Lower piezometer string down into the casing to the predetermined depth.
5. Following installation of the piezometer pipe through the augers, the augers will be pulled back to approximately 3 feet below ground surface to allow for natural cave-in of soils around the piezometer screen.
6. Bentonite Seal:
 - a. Use bentonite chips or pellets no larger than 3/8 inch in diameter when placing seal through water.
 - b. The bentonite seal will be installed to extend to the ground surface.

- c. Record the type, size, and volume of sealant placed.

C. After Piezometer Installation

1. Check for settlement of the ground surface seal; top off as necessary.
2. Label the PVC riser pipe with the piezometer number.
3. Lubricate the well lock.
 - a. Do not use WD-40 or penetrating oils.
 - b. Remove the lock away from the well and lubricate it with liquid graphite.
 - c. Wipe off excess lubricant, allow the lock to "dry", then return it to the well.
4. Clean up the area: pick up trash, do not burn; pick up cuttings; use a broom, rake, or hose down the area.

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APRIL 29, 1996 U.S. EPA LETTER



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

77 WEST JACKSON BOULEVARD

CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

April 29, 1996

EXPRESS MAIL
AND BY FACSIMILE

Mr. Ronald Frehner
Project Coordinator - ACS NPL Site
Conestoga-Rovers & Associates
1801 Old Highway 8, Suite 114
St. Paul, Minnesota 55112

RE: Clarification of Disapproval of March 1996
Upper Aquifer Technical Memorandum;
American Chemical Service, Inc. Site;
Griffith, Indiana

Dear Mr. Frehner:

This letter serves to clarify the United States Environmental Protection Agency's (U.S. EPA) disapproval letter dated April 10, 1996, of the March 1996, Upper Aquifer Technical Memorandum submitted by Montgomery Watson on behalf of Respondents for the American Chemical Service, Inc. Site located in Griffith, Indiana (ACS Site) in accordance with the Unilateral Administrative Order (UAO or Order) (Docket V-W-95-C-C-260).

As you know, U.S. EPA and the Indiana Department of Environmental Management (IDEM) met with Respondents on April 23, 1996, to discuss the U.S. EPA disapproval of the Upper Aquifer Technical Memorandum and the proposed wells in accordance with Task 7A of the partially approved Pre-Design Work Plan. The Pre-Design Work Plan was partially approved by U.S. EPA on September 21, 1995, and modified on April 15, 1996; in that approval, U.S. EPA established a process of working through the complex hydrogeologic issues at ACS whereby screening level data would be gathered by the "tracer investigation", and then confirmatory data would be collected from monitoring wells.

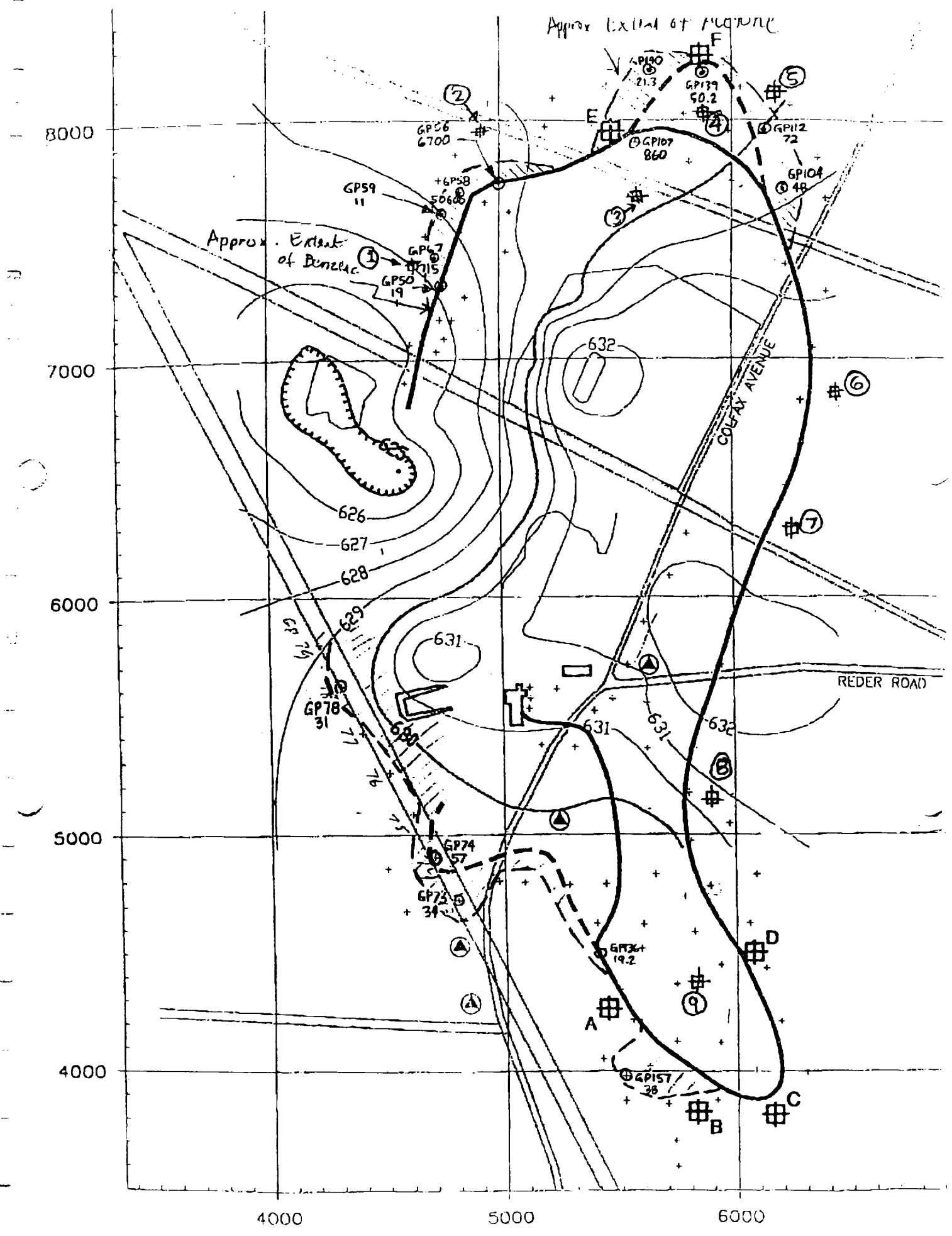
This iterative process was established to derive a meaningful groundwater monitoring network, pre-design data to establish the pre-remediation conditions, the scope of the necessary upper and lower groundwater remediation and to determine the effectiveness of any groundwater extraction and treatment system.

Groundwater wells are necessary to accurately confirm character, nature and extent of groundwater contamination (including presence and absence of contamination). Piezometers are necessary to confirm the complex localized groundwater flow regimes in the vicinity of the site. This data will be used to set up both compliance and detection monitoring network.

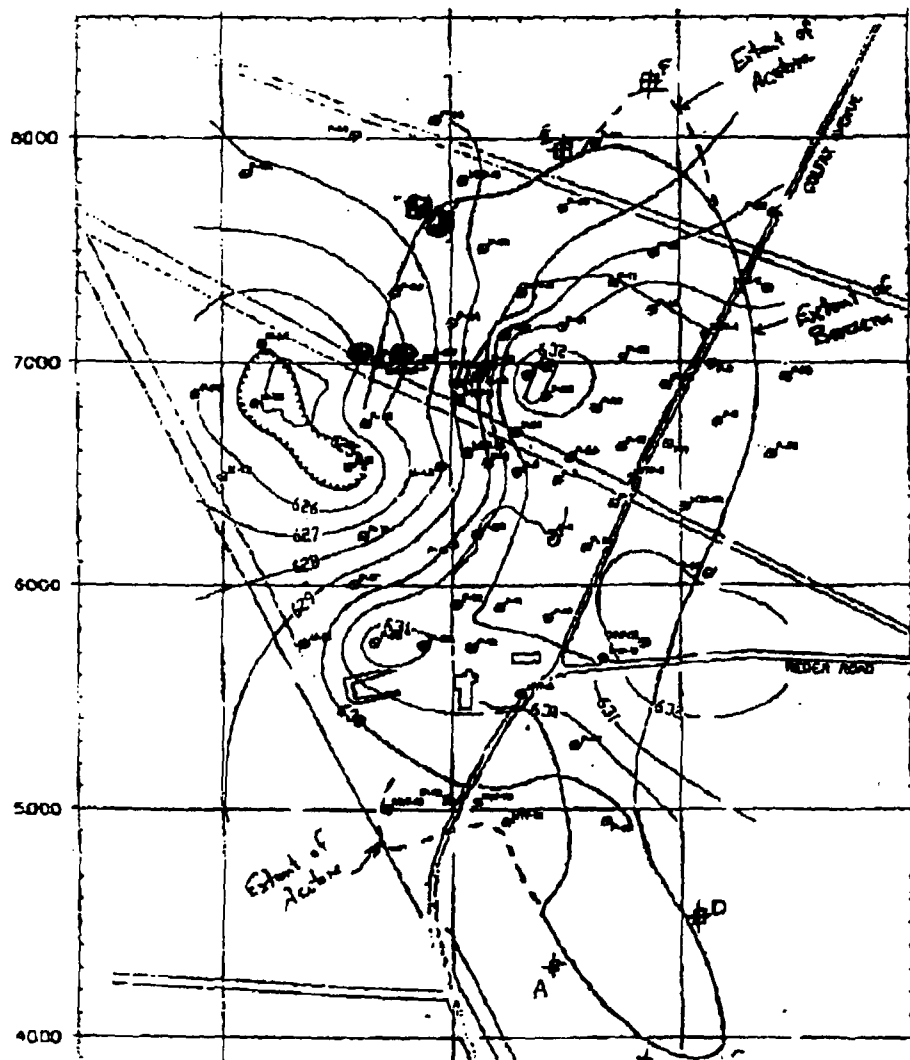
Although you were not present at the meeting as the Project Coordinator, Mr. Mark Travers was there in your absence. At that meeting Respondents questioned the purpose of the ongoing groundwater investigation and did not believe confirmatory wells are necessary.

For clarification, the UAO authorizes the additional groundwater characterization work and monitoring as required by EPA and IDEM. For example, Section II.C.1. of the UAO Statement of Work (SOW) states that "Respondents shall perform sufficient additional sampling to identify the horizontal and vertical extent of groundwater contamination in order to assess the degree of contaminant migration and to facilitate the design in of an effective groundwater treatment system. This shall include implementation of a groundwater monitoring program designed to detect changes in water quality or concentration of hazardous substances, contaminants or pollutants in the groundwater at and beyond the point-of-compliance and shall include upgradient, downgradient and transgradient. The groundwater monitoring program shall provide for verification sampling and updating of the current local hydrogeological setting and associated condition. . ."

Section II.E.1. of the UAO SOW states that "Respondents shall design, construct, operate, and maintain a groundwater extraction and treatment system to restore groundwater to performance standards. Performance standards include cleanup standards, standards of control, quality criteria in and other substantive requirements" (UAO SOW Section II). Additionally, the system must be designed to dewater the site. "The Respondents shall install and operate an extraction system that shall consist of a network of wells designed to completely capture and remove contaminated groundwater within the Area of Attainment. . . The [monitoring] frequency shall, at a minimum, document Site conditions, contaminant concentrations, and water levels prior to startup of the system, at startup, and during operation such that a change in these parameters or Site conditions is noted in a timely manner so as to avoid adverse impacts to the environment while maximizing performance. Approval of the above work shall be made by EPA, after reasonable opportunity for review and comment by the State." (UAO SOW Section II.E.1.) The UAO also states that both a groundwater compliance and detection monitoring network shall be established. (UAO SOW Section II.F.5).



ENCLOSURE B



Approximate
proposed piezometer
locations

(2 piezometers per
location)

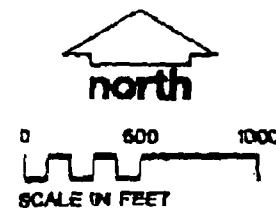
Note P. 23 may be used if
appropriate

LEGEND

- ★ Proposed New Upper Aquifer Monitoring Well
- UPPER AQUIFER WELL LOCATION AND NUMBER
- LEACHATE/UPPER AQUIFER WELL LOCATION AND NUMBER
- PIEZOMETER LOCATION AND NUMBER
- CIRCUMFERENTIAL ELEVATION CONTOUR

LEGEND

- 1. CIRCUMFERENTIAL ELEVATION WAS MEASURED AT THE SITE ON OCTOBER 30, 1993.



Drawn by	CCM
Checked by	CCM
Approved by	CCM
Reviewed by	CCM
Existing and Proposed Monitoring Well Location	